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Pinewood Atlanta – Phase 1A
Building 3

Fayetteville, GA

HVAC O&M Manuals

6/5/2014

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Mechanical Engineer: Paulson-Cheek Mechanical, Inc.

Mechanical Contractor: Paulson-Cheek Mechanical, Inc.

Section 1	Rooftop Units
Section 2	Exhaust Fans
Section 3	Electric Heaters
Section 4	Variable Frequency Drives
Section 5	Starters

O&M COVER SHEET

SECTION: 1
PRODUCT: ROOFTOP UNITS

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PROJECT: **Pinewood Atlanta - Building 3**

LOCATION: **Fayetteville, GA**

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DATE RECEIVED:	06/05/14
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[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

THIS APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE SUBCONTRACTOR OR VENDOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

CHECKED BY:	WILLIAM HAGLER
DATE CHECKED:	06/05/14

INSTALLATION MANUAL

R-410A
SERIES 20 JZJ**

15 - 25 Ton

60 Hertz

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General

Johnson Controls Series 20 J**ZJ models are either single package air conditioners equipped with optional factory installed electric heaters, or single package gas-fired central heating furnaces with cooling unit. Both are designed for outdoor installation on a rooftop or slab.

The units are completely assembled on rigid, permanently attached base rails. All piping, refrigerant charge, and electrical wiring is factory installed and tested. The units require electric power, gas connection, duct connections, installation of combustion air inlet hood, flue gas outlet hoods and fixed outdoor air intake damper (units without economizer or motorized damper option only) at the point of installation.

The supplemental electric heaters have nickel-chrome elements and utilize single point power connection.

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot. All gas heaters are shipped from the factory equipped for natural gas use, but can be field converted to L.P./Propane with Kit Model # 1NP0418. See Gas Heat Application Data Table.

Safety Considerations

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention the signal words **DANGER**, **WARNING** or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury.**

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury.**

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠ CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state and national codes including, but not limited to building, electrical, and mechanical codes.

⚠WARNING

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock could cause personal injury. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system. Gage sets, hoses, refrigerant containers and recovery systems must be designed to handle R-410A. If you are unsure, consult the equipment manufacturer. Failure to use R-410A compatible servicing equipment may result in property damage or injury.

⚠WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

a. Do not try to light any appliance.

b. Do not touch any electrical switch; do not use any phone in your building.

c. Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

d. If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Due to system pressure, moving parts, and electrical components, installation and servicing of air conditioning equipment can be hazardous. Only qualified, trained service personnel should install, repair, or service this equipment. Untrained personnel can perform basic maintenance functions of cleaning coils and filters and replacing filters.

Observe all precautions in the literature, labels, and tags accompanying the equipment whenever working on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including ANSI Z223.1 or CSA-B149.1- latest edition.

Wear safety glasses and work gloves. Use quenching cloth and have a fire extinguisher available during brazing operations.

Inspection

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing.

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state and national codes including, but not limited to, building, electrical, and mechanical codes.

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

Reference

Additional information is available in the following reference forms:

- Technical Guide - J15 thru 25 ZJ/ZR/ZF, 349690
- General Installation - J15 thru 25 ZJ, 860261

Renewal Parts

For authorized replacement parts call Johnson Controls, Inc. National Source 1 Parts outlet at 1-866-523-9670.

Approvals

Design certified by CSA as follows:

1. For use as a cooling only unit, cooling unit with supplemental electric heat or a forced air furnace.
2. For outdoor installation only.
3. For installation on combustible material.
4. For use with natural gas (convertible to LP with kit).

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state, and national codes including, but not limited to, building, electrical, and mechanical codes.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

Nomenclature

15-25 Ton Series 20 Model Number Nomenclature

J15	Z	J	N24	A	2	A	AA	1	0	1	2	4	A

Nominal Cooling Capacity

J15 = 15 Ton
J18 = 17.5 Ton
J20 = 20 Ton
J25 = 25 Ton

Product Category

Z = A/C, Single Pkg., R-410A

Product Identifier

J = 11.0+ EER A/C

Heat Type and Nominal Heat Capacity

C00 = Cooling Only. No field installed electric heat

Gas Heat Options

N24 = 240 MBH Output Aluminized Steel
N32 = 320 MBH Output Aluminized Steel
S24 = 240 MBH Output Stainless Steel
S32 = 320 MBH Output Stainless Steel

Electric Heat Options

E18 = 18 KW
E36 = 36 KW
E54 = 54 KW
E72 = 72 KW

Airflow

A = Std. Motor
B = Std. Motor/Economizer
C = Std. Motor/Economizer/Power Exhaust (Downflow Only)
D = Std. Motor/Motorized Damper
E = Std. Motor/Motorized Damper/Barometric Relief
J = Std. Motor/Economizer/Barometric Relief
N = Hi Static
P = Hi Static/Economizer
Q = Hi Static/Economizer/Power Exhaust (Downflow Only)
R = Hi Static/Motorized Damper
K = Hi Static/Motorized Damper/Barometric Relief
S = Hi Static/Economizer/Barometric Relief
2 = Low Static
3 = Low Static/Economizer
4 = Low Static/Economizer/Power Exhaust (Downflow Only)
5 = Low Static/Motorized Damper
6 = Low Static/Motorized Damper/Barometric Relief
7 = Low Static/Economizer/Barometric Relief

Voltage

2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60

Product Style

A = Style A

Configuration Options (not required for all units)
These four digits will not be assigned until a quote is requested, or an order placed.

- SS Drain Pan
- Johnson UNT 1126 Controller (N2 protocol), DFS, APS
- Johnson Commercial Controls System (CCS) Rtu Controller
- Johnson Controller Metasys FEC-2611 (BACnet MS/TP Protocol), SAS, RAS, OAS, DFS, APS
- CPC Controller, DFS, APS
- Honeywell Controller, DFS, APS
- Novar Controller, DFS, APS
- Simplicity IntelliComfort II Controller
- Simplicity IntelliComfort II Controller w/Simplicity™LINC
- Hot Gas Bypass (Standard on VAV, Optional on CV)
- Variable Air Volume, VFD
- Variable Air Volume, VFD and Manual Bypass
- Variable Air Volume, VFD (BAS ready - for customer provided VFD controller)
- Variable Air Volume, VFD and Manual Bypass (BAS ready)
- Variable Air Volume, VFD Ready (for customer provided, field installed drive)
- 2" Pleated Filters, MERV 7
- 4" Pleated Filters, MERV 13
- BAS Ready Economizer (2-10 V.D.C. Actuator without a controller)
- Double Wall Construction

For valid combinations of the above; see the equipment price pages or the Unitary Sales Tool program; all combinations are not available

Product Generation

1 = First Generation

Additional Options

Standard Cabinet	Hinged Filter Door & Tool Free Access Cabinet
AA = None AB = Phase Monitor AC = Coil Guard AD = Dirty Filter Switch AE = Phase Monitor & Coil Guard AF = Phase Monitor & Dirty Filter Switch AG = Coil Guard & Dirty Filter Switch AH = Phase Monitor, Coil Guard & Dirty Filter Switch RC = Coil Guard & American Flag TA = Technicoat Condenser Coil TJ = Technicoat Evaporator Coil TS = Technicoat Evaporator & Condenser Coils EA = ElectroFin Condenser Coil EJ = ElectroFin Evaporator Coil ES = ElectroFin Cond & Evap Coils	BA = Hinged Filter Door & Tool Free Access Panels BB = Phase Monitor, Hinged Filter Door & Tool Free Access Panels BC = Coil Guard, Hinged Filter Door & Tool Free Access Panels BD = Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BE = Phase Monitor & Coil Guard, Hinged Filter Door & Tool Free Access Panels BF = Phase Monitor & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BG = Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BH = Phase Monitor, Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels

ZZ = If desired option combination is not listed above, ZZ will be assigned and configuration options will be located in digits 15-18.

Installation Options

A = No Options Installed B = Option 1 C = Option 2 D = Options 1 & 2 E = Option 3 F = Option 4 G = Options 1 & 3 H = Options 1 & 4 J = Options 1, 2 & 3 K = Options 1, 2, & 4 L = Options 1,3 & 4 M = Options 1, 2, 3, & 4	N = Options 2 & 3 P = Options 2 & 4 Q = Options 2, 3, & 4 R = Options 3 & 4 S = Option 5 T = Options 1 & 5 U = Options 1, 3, & 5 V = Options 1, 4, & 5 W = Options 1, 3, 4, & 5 X = Options 3 & 5 Y = Options 4 & 5 Z = Options 3, 4 & 5

Options

1 = Disconnect 2 = Non-Pwr'd Conv. Outlet 3 = Smoke Detector S.A.	4 = Smoke Detector R.A. 5 = Pwr'd Conv. Outlet

Installation

Installation Safety Information

Read these instructions before continuing this appliance installation. This is an outdoor combination heating and cooling unit. The installer must assure that these instructions are made available to the consumer and with instructions to retain them for future reference.

1. Refer to the unit rating plate for the approved type of gas for this product.
2. Install this unit only in a location and position as specified on Page 7 of these instructions.
3. Never test for gas leaks with an open flame. Use commercially available soap solution made specifically for the detection of leaks when checking all connections, as specified on Pages 5, 28 and 52 of these instructions.
4. Always install furnace to operate within the furnace's intended temperature-rise range with the duct system and within the allowable external static pressure range, as specified on the unit name/rating plate, specified on Page 27 of these instructions.
5. This equipment is not to be used for temporary heating of buildings or structures under construction.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

6. If a factory option convenience outlet is installed, the weatherproof outlet cover must be field installed. The cover shall be located in the unit control box. To install the cover, remove the shipping label covering the convenience outlet, follow the instructions on the back of the weatherproof cover box, and attach the cover to the unit using the (4) screws provided.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units with factory installed Powered Convenience Outlet Option are wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.

Limitations

These units must be installed in accordance with the following:

In U.S.A.:

1. National Electrical Code, ANSI/NFPA No. 70 - Latest Edition
2. National Fuel Gas Code, ANSI Z223.1 - Latest Edition
3. Gas-Fired Central Furnace Standard, ANSI Z21.47a. - Latest Edition
4. Local building codes, and
5. Local gas utility requirements

In Canada:

1. Canadian Electrical Code, CSA C22.1
2. Installation Codes, CSA - B149.1.
3. Local plumbing and waste water codes, and
4. Other applicable local codes.

Refer to unit application data found in this document.

After installation, gas fired units must be adjusted to obtain a temperature rise within the range specified on the unit rating plate.

If components are to be added to a unit to meet local codes, they are to be installed at the dealer's and/or customer's expense.

Size of unit for proposed installation should be based on heat loss/heat gain calculation made according to the methods of Air Conditioning Contractors of America (ACCA).

This furnace is not to be used for temporary heating of buildings or structures under construction.

⚠ CAUTION

The control board used in this product will effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When applying this product for process cooling applications (computer rooms, switchgear, etc.), please reference applications bulletin AE-011-07 or call the applications department for Unitary Products @ 1-877-UPG-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.

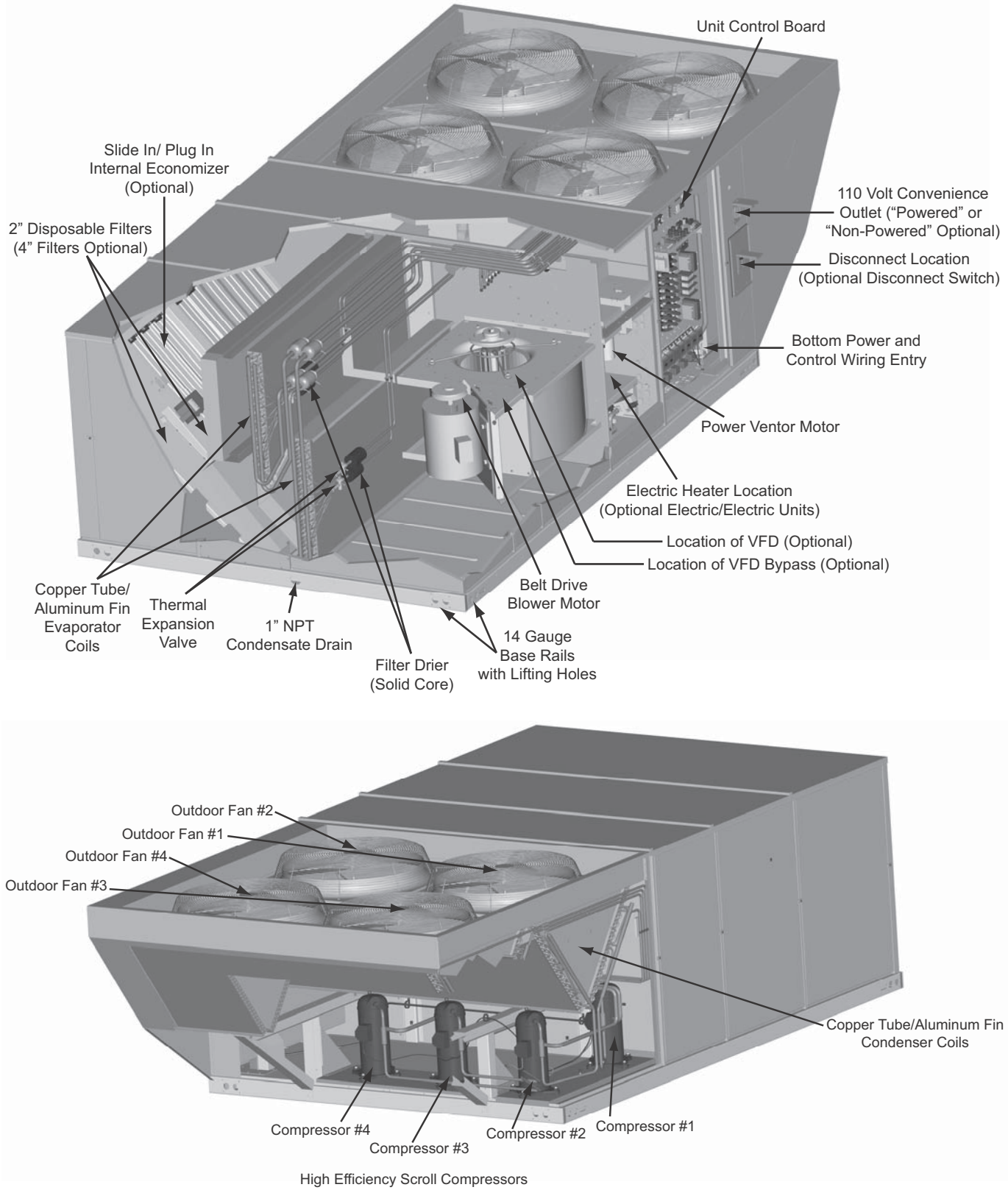


Figure 1: J15 thru 25 ZJ Component Location

Table 1: J15 thru 25 ZJ Unit Limitations

Size (Tons)	Unit Voltage	Unit Limitations		
		Applied Voltage		Outdoor DB Temp
		Min	Max	Max (°F)
J15 (15)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
J18 (17.5)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
J20 (20)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
J25 (25)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125

Location

Use the following guidelines to select a suitable location for these units:

1. Unit is designed for *outdoor installation only*.
2. Condenser coils must have an unlimited supply of air. Where a choice of location is possible, position the unit on either north or east side of building.
3. Suitable for mounting on roof curb.
4. For ground level installation, use a level concrete slab with a minimum thickness of 4 inches. The length and width should be at least 6 inches greater than the unit base rails. Do not tie slab to the building foundation.
5. Roof structures must be able to support the weight of the unit and its options/accessories. Unit must be installed on a solid, level roof curb or appropriate angle iron frame.
6. Maintain level tolerance to 1/2” across the entire width and length of unit.

⚠WARNING

Excessive exposure of this furnace to contaminated combustion air may result in equipment damage or personal injury. Typical contaminates include: permanent wave solution, chlorinated waxes and cleaners, chlorine based swimming pool chemicals, water softening chemicals, carbon tetrachloride, Halogen type refrigerants, cleaning solvents (e.g. perchloroethylene), printing inks, paint removers, varnishes, hydrochloric acid, cements and glues, antistatic fabric softeners for clothes dryers, masonry acid washing materials.

Clearances

All units require particular clearances for proper operation and service. Installer must make provisions for adequate combustion and ventilation air in accordance with section 5.3 of Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 – Latest Edition (in U.S.A.), or Sections 7.2, 7.3, or 7.4 of Gas Installation Codes, CSA-B149.1 (in Canada) - Latest Edition, and/or applicable provisions of the local building codes. Refer to Table 6 for clearances required for combustible construction, servicing, and proper unit operation.

⚠WARNING

Do not permit overhanging structures or shrubs to obstruct condenser air discharge outlet, combustion air inlet or vent outlets.

Rigging And Handling

Exercise care when moving the unit. Do not remove any packaging until the unit is near the place of installation. Rig the unit by attaching chain or cable slings to the lifting holes provided in the base rails. Spreader bars, whose length exceeds the largest dimension across the unit, **MUST** be used across the top of the unit.

⚠ CAUTION

If a unit is to be installed on a roof curb other than a Unitary Products roof curb, gasketing must be applied to all surfaces that come in contact with the unit underside.

⚠ CAUTION

Before lifting, make sure the unit weight is distributed equally on the rigging cables so it will lift evenly.

Units may be moved or lifted with a forklift, from the side only, providing an accessory skid is used.

LENGTH OF FORKS MUST BE A MINIMUM OF 90 INCHES.

⚠ CAUTION

All panels must be secured in place when the unit is lifted.

The condenser coils should be protected from rigging cable damage with plywood or other suitable material.

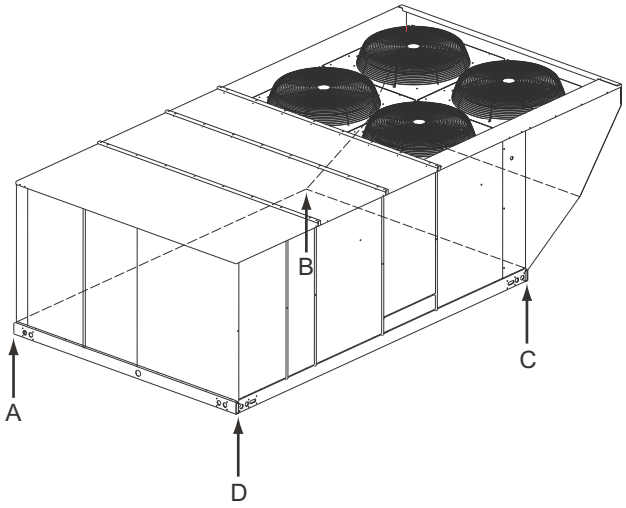


Figure 2: Unit 4 Point Load Weight

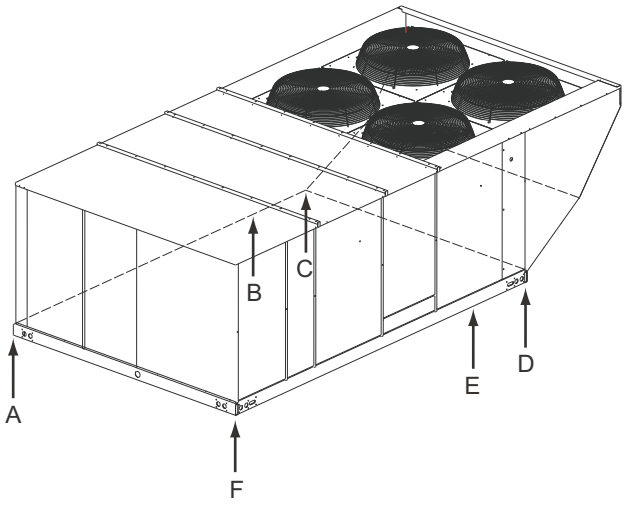


Figure 3: Unit 6 Point Load Weight

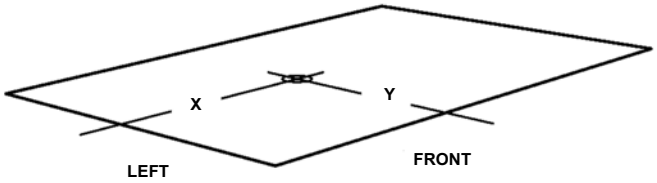


Figure 4: Center of Gravity

Table 2: Weights and Dimensions

Size	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
(Tons)	Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
J15ZJ (15)	2614	2609	85.25	44	467	781	852	510	287	392	568	620	428	313
J18ZJ (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
J20ZJ (20)	2702	2697	85.05	44	485	805	878	529	298	406	585	638	443	326
J25ZJ (25)	2788	2783	85.25	44	498	833	908	544	306	419	606	661	457	334

Table 3: J15 thru 25 ZJ Unit Accessory Weights

Unit Accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	165	160
Power Exhaust	90	85
Electric Heat[1]	40	40
Gas Heat[2]	240	240
Double Wall	260	260
Motorized Damper	150	150
Barometric Damper	50	45
Econ./Motorized Damper Rain Hood	60	55
Econ./Power Exhaust Rain Hood	95	90
Wood Skid	220	220
Roof Curb	190	185
Hot Gas Bypass	10	10
Supply Fan VFD	See Table 5	

1. Weight given is for the maximum heater size available (54KW).
2. Weight given is for the maximum number of tube heat exchangers available (8 tube).

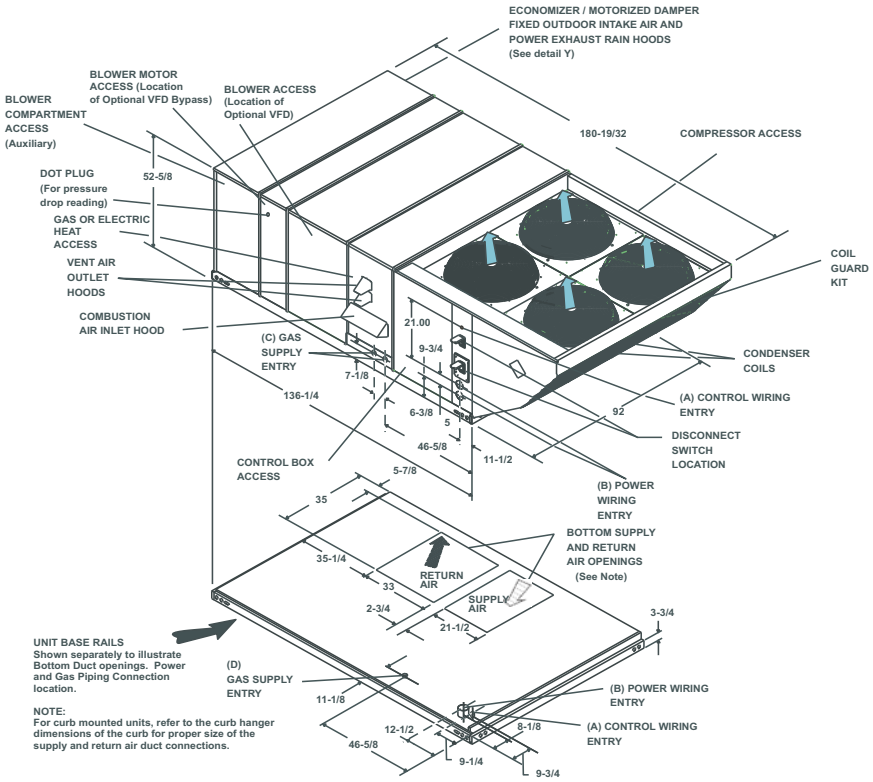


Figure 5: J15 thru 25 ZJ Unit Dimensions Front View

Table 4: Utilities Entry

Hole	Opening Size Diameter	Used For	
A	1-1/8" KO	Control Wiring	Front
	3/4" NPS (Fem.)		Bottom
B	3-5/8" KO	Power Wiring	Front
	3" NPS (Fem.)		Bottom
C	2-3/8" KO	Gas Piping (Front)[1]	
D	1-11/16" Hole	Gas Piping (Bottom)[1,2]	

1. One-inch Gas Piping NPT Required.
2. Opening in the bottom to the unit can be located by the slice in the insulation.

Note: All entry holes should be sealed to prevent rain water entry into building.

Table 5: Supply Fan VFD Weights, In Lbs.

Supply Fan Motor	230V	460V	575V
W/O Manual Bypass			
5.0 hp	25	25	30
7.5 hp	30	30	30
10.0 hp	30	30	35
15.0 hp	30	30	40
W/Manual Bypass			
5.0 hp	30	30	35
7.5 hp	35	35	35
10.0 hp	35	35	40
15.0 hp	40	35	45

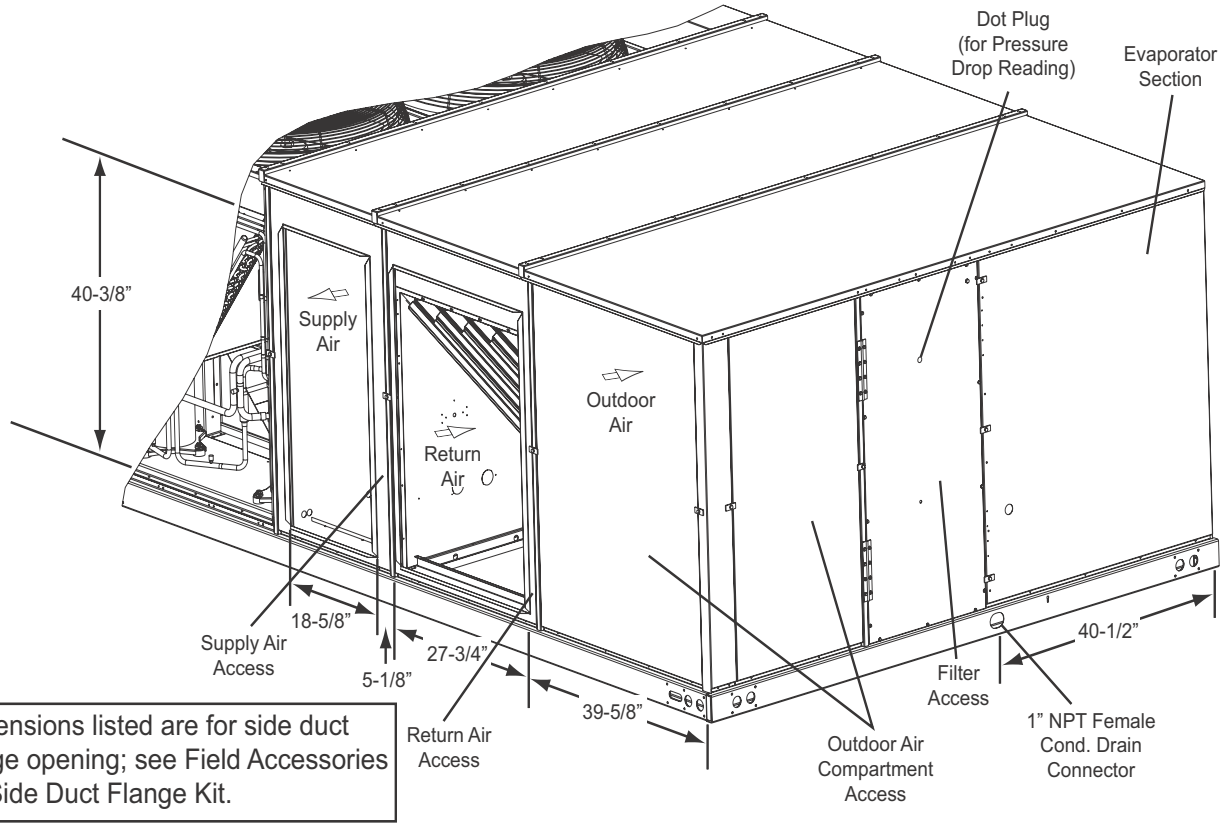


Figure 6: J15 thru 25 ZJ Unit Dimensions Rear View

NOTE: Units are shipped with the bottom duct openings covered. An accessory flange kit is available for connecting side ducts.

For <u>bottom</u> duct applications:

1. Remove the side panels from the supply and return air compartments to gain access to the bottom supply and return air duct covers.
2. Remove and discard the bottom duct covers. Duct openings are closed with sheet metal covers except when the unit includes a power exhaust option. The covering consists of a heavy black paper composition.
3. Replace the side supply and return air compartment panels.

For <u>side</u> duct applications:

1. Replace the side panels on the supply and return air compartments with the accessory flange kit panels.
2. Connect ductwork to the flanges on those panels.

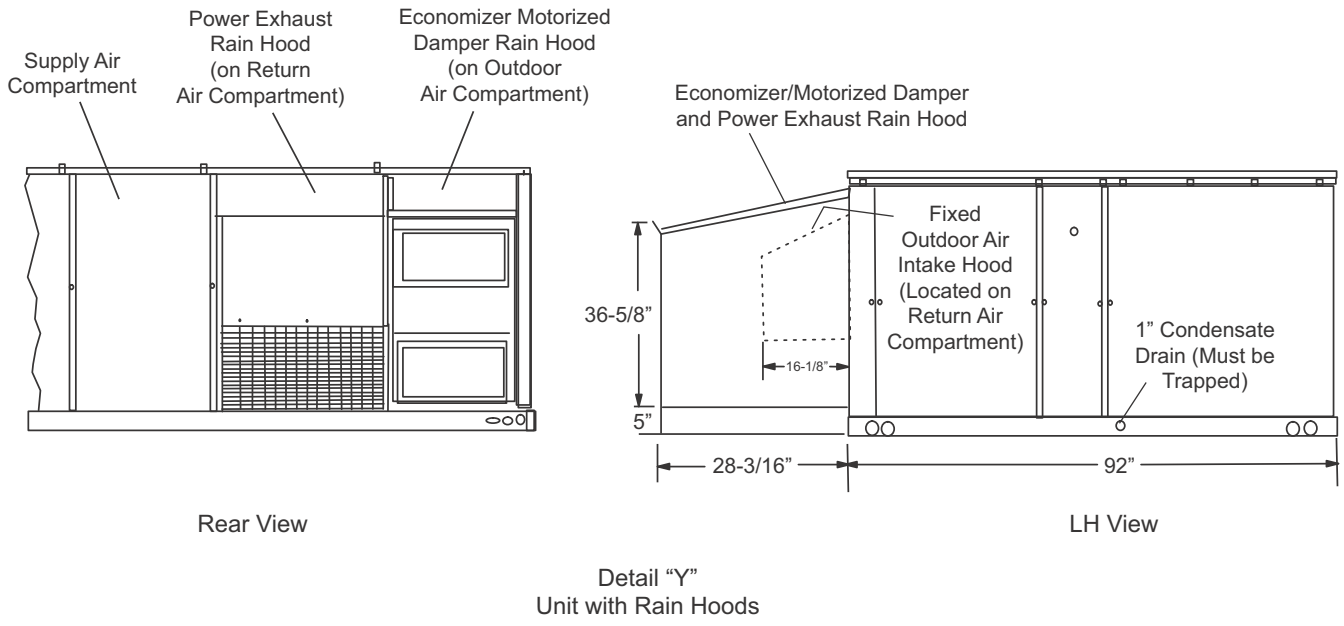


Figure 7: J15 thru 25 ZJ Unit Dimensions Rain Hood

Table 6: J15 thru 25 ZJ Unit Clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72 With 36 Maximum Horizontal Overhang (For Condenser Air Discharge)	Right	36
Front	36	Bottom[2]	0
Rear	24 (W/O Economizer)	Left	24 (W/O Economizer)
	49 (W/Economizer)		36 (W/Economizer)[3]

1. Units must be installed outdoors. Over hanging structure or shrubs should not obscure condenser air discharge outlet.
2. Units may be installed on combustable floors made from wood or class A, B or C roof covering materials.
3. If economizer is factory installed, the unassembled rain hood must be removed from its ride along position in front of the evaporator coil, or in the outdoor air compartment, prior to final installation.

Note: ELEC/ELEC Models: Units and ductwork are approved for zero clearance to combustible material when equipped with electric heaters.

GAS/ELEC Models: A 1" clearance must be provided between any combustible material and the supply air ductwork for a distance of 3 feet from the unit.

The products of combustion must not be allowed to accumulate within a confined space and recirculate.

Locate unit so that the vent air outlet hood is at least:

- Three (3) feet above any force air inlet located within 10 horizontal feet (excluding those integral to the unit).
- Four (4) feet below, four horizontal feet from, or one foot above any door or gravity air inlet into the building.
- Four (4) feet from electric and gas meters, regulators and relief equipment.

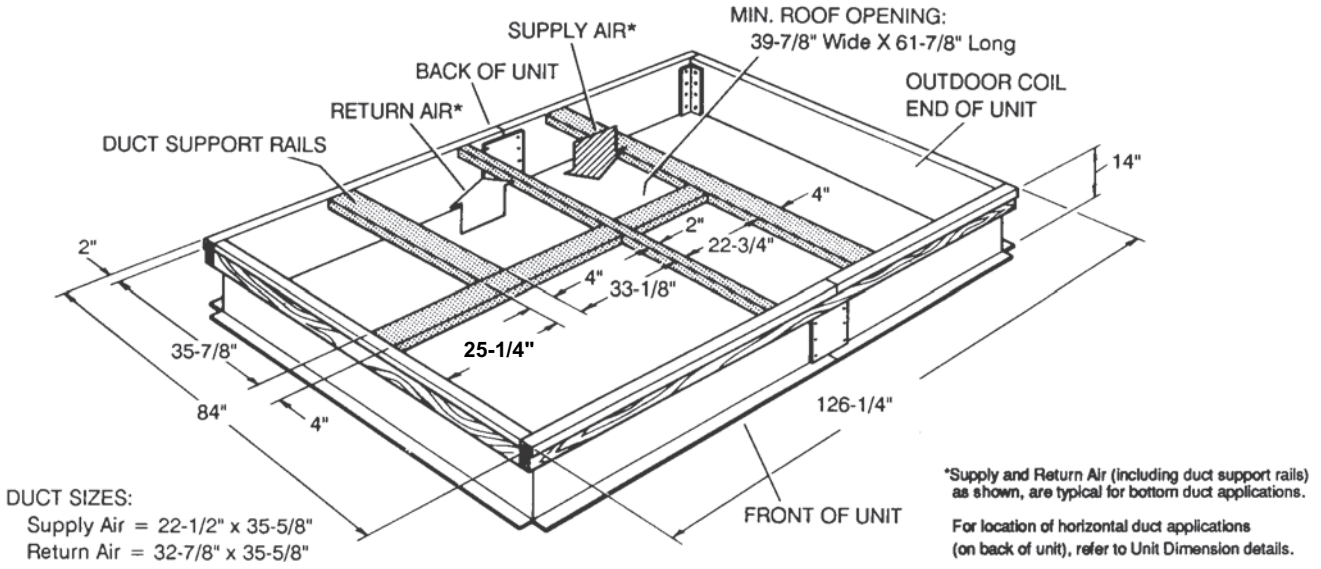


Figure 8: J15 thru 25 ZJ Roof Curb

Ductwork

Ductwork should be designed and sized according to the methods in Manual D of the Air Conditioning Contractors of America (ACCA) or as recommended by any other recognized authority such as ASHRAE or SMACNA.

A closed return duct system should be used. This will not preclude use of economizers or outdoor fresh air intake. The supply and return air duct connections at the unit should be made with flexible joints to minimize noise.

The supply and return air duct systems should be designed for the CFM and static pressure requirements of the job. They should NOT be sized to match the dimensions of the duct connections on the unit.

Refer to Figure 5 for bottom air duct openings. Refer to Figure 6 for side air duct openings.

NOTE: It is recommended that, in Canada, the outlet duct be provided with a removable access panel. It is recommended that this opening be accessible when the unit is installed in service, and of a size such that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The cover should be attached in a manner adequate to prevent leakage.

Fixed Outdoor Air Intake Damper

This damper is shipped inside the return air compartment. It is completely assembled and ready for installation. A damper baffle inside of the hood is adjustable to provide variable amounts of outdoor air intake on units that are not provided with an economizer or a motorized damper option. Refer to the Fixed Outdoor Damper Figure 9.

Gasketing and mounting screws are provided in a parts bag attached to the hood assembly. Apply gasketing to the three flange surfaces on the hood prior to installing the hood. Extend gasketing 1/4 inch beyond the top and bottom of the two side flanges to insure adequate sealing.

Adjusting the damper to the desired air flow may be done before mounting the hood into position or after installation by removing the front hood panel or the screen on the bottom of the hood. Damper baffle in position 1 will allow approximately 10% outdoor air flow, position 2 approximately 15% and, to allow approximately 25%, remove the damper baffle.

On units with bottom return air application install the damper assembly over the opening in the side return air access panel. Remove and discard the opening cover and the covering over the hood mounting holes (used for shipping) before installing. Secure with the screws provided.

On units with side return air applications, install the damper assembly on the return air ductwork as close to the unit as possible. Cut an opening 16 inches high by 18 inches wide in the ductwork to accommodate the damper. Using the holes in the hood flanges as a template, drill 9/64 inch diameter (#26 drill) holes into the ductwork and secure with the screws provided.

⚠ CAUTION

If outdoor air intake will not be required on units with bottom return air applications, the damper assembly should still be mounted on the side return air access panel, per the instructions above, to insure moisture is not drawn into the unit during operation. The covering over the mounting holes only need be removed. Do not remove the opening cover.

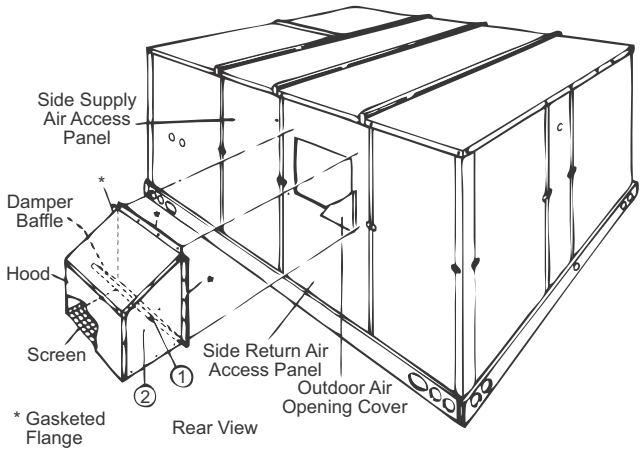


Figure 9: Fixed Outdoor Air Damper

Condensate Drain

Plumbing must conform to local codes. Use a sealing compound on male pipe threads. Install a condensate drain line from the one-inch NPT female connection on the unit to an open drain.

NOTE: The condensate drain operates in a negative pressure in the cabinet. The condensate drain line MUST be trapped to provide proper drainage. See Figure 10.

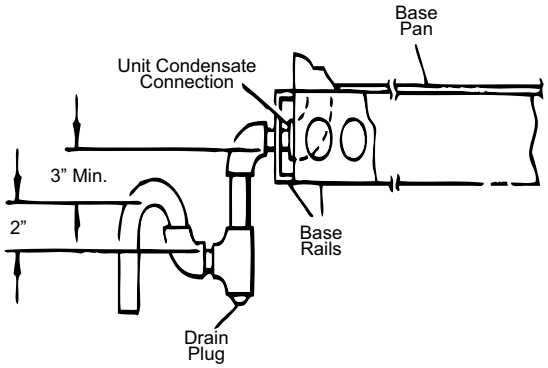


Figure 10: Condensate Drain

Compressors

The scroll compressor used in this product is specifically designed to operate with R-410A Refrigerant and cannot be interchanged.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

The compressor also uses a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oil can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. Take all necessary precautions to avoid exposure of the oil to the atmosphere.

⚠ CAUTION

Do not leave the system open to the atmosphere. Unit damage could occur due to moisture being absorbed by the **POE oil** in the system. This type of oil is highly susceptible to moisture absorption

POE (polyolester) compressor lubricants are known to cause long term damage to some synthetic roofing materials.

⚠ CAUTION

Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When performing any service that may risk exposure of compressor oil to the roof, take precautions to protect roofing.

Procedures which risk oil leakage include, but are not limited to, compressor replacement, repairing refrigerant leaks, replacing refrigerant components such as filter drier, pressure switch, metering device or coil.

Units are shipped with compressor mountings which are factory-adjusted and ready for operation.

⚠ CAUTION

Do not loosen compressor mounting bolts.

Filters

Two-inch filters are supplied with each unit, but units can be converted easily to four-inch filters. Filters must always be installed ahead of the evaporator coil and must be kept clean or replaced with same size and type. Dirty filters will reduce the capacity of the unit and will result in frosted coils or safety shutdown. Minimum filter area and required sizes are shown in Physical Data Table 9.

⚠ CAUTION

Make sure that panel latches are properly positioned on the unit to maintain an airtight seal.

Power And Control Wiring

Field wiring to the unit, fuses, and disconnects must conform to provisions of National Electrical Code (NEC), ANSI/NFPA No. 70 – Latest Edition (in U.S.A.), current Canadian Electrical Code C221, and/or local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified above and/or local codes.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.

Voltage tolerances which must be maintained at the compressor terminals during starting and running conditions are indicated on the unit Rating Plate and Table 1.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. Field alteration to comply with electrical codes should not be required. If any of the wire supplied with the unit must be replaced, replacement wire must be of the type shown on the wiring diagram and the same minimum gauge as the replaced wire.

A disconnect must be utilized for these units. Factory installed disconnects are available. If installing a disconnect (field supplied or Unitary Products supplied accessory), refer to Figure 1 for the recommended mounting location.

⚠ CAUTION

Avoid damage to internal components if drilling holes for disconnect mounting.

NOTE: Since not all local codes allow the mounting of a disconnect on the unit, please confirm compliance with local code before mounting a disconnect on the unit.

Electrical line must be sized properly to carry the load. USE COPPER CONDUCTORS ONLY. Each unit must be wired with a separate branch circuit fed directly from the meter panel and properly fused.

Refer to Figures 11 and 12 for typical field wiring and to the appropriate unit wiring diagram mounted inside control doors for control circuit and power wiring information.

⚠ CAUTION

When connecting electrical power and control wiring to the unit, water-proof connectors must be used so that water or moisture cannot be drawn into the unit during normal operation. The above water-proofing conditions will also apply when installing a field supplied disconnect switch.

Power Wiring Detail

Units are factory wired for the voltage shown on the unit nameplate. Refer to Electrical Data Table 8 to size power wiring, fuses, and disconnect switch.

Power wiring is brought into the unit through the side of the unit or the basepan inside the curb.

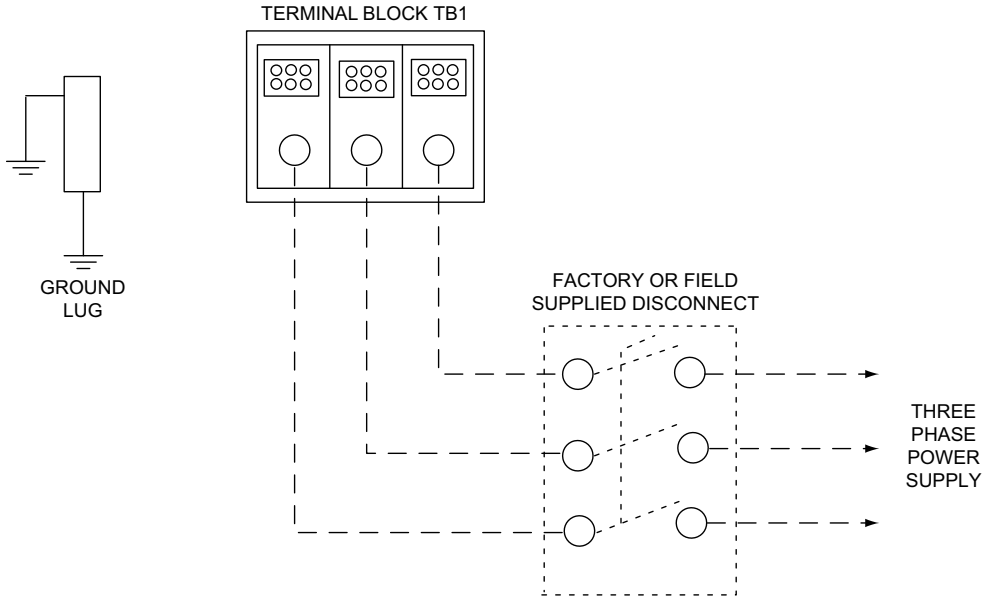


Figure 11: Field Wiring Disconnect - Cooling Unit With/Without Electric Heat

Thermostat Wiring

The thermostat should be located on an inside wall approximately 56 inch above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow the manufacturer's instructions enclosed with thermostat for general installation procedure. Seven (7) color-coded, insulated wires should be used to connect the thermostat to the unit. Refer to Table 7 for control wire sizing and maximum length.

Space Sensor

The space sensor, if used, should be located on an inside wall approximately 56 inches above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow manufacturer's instructions enclosed with sensor for general installation procedure.

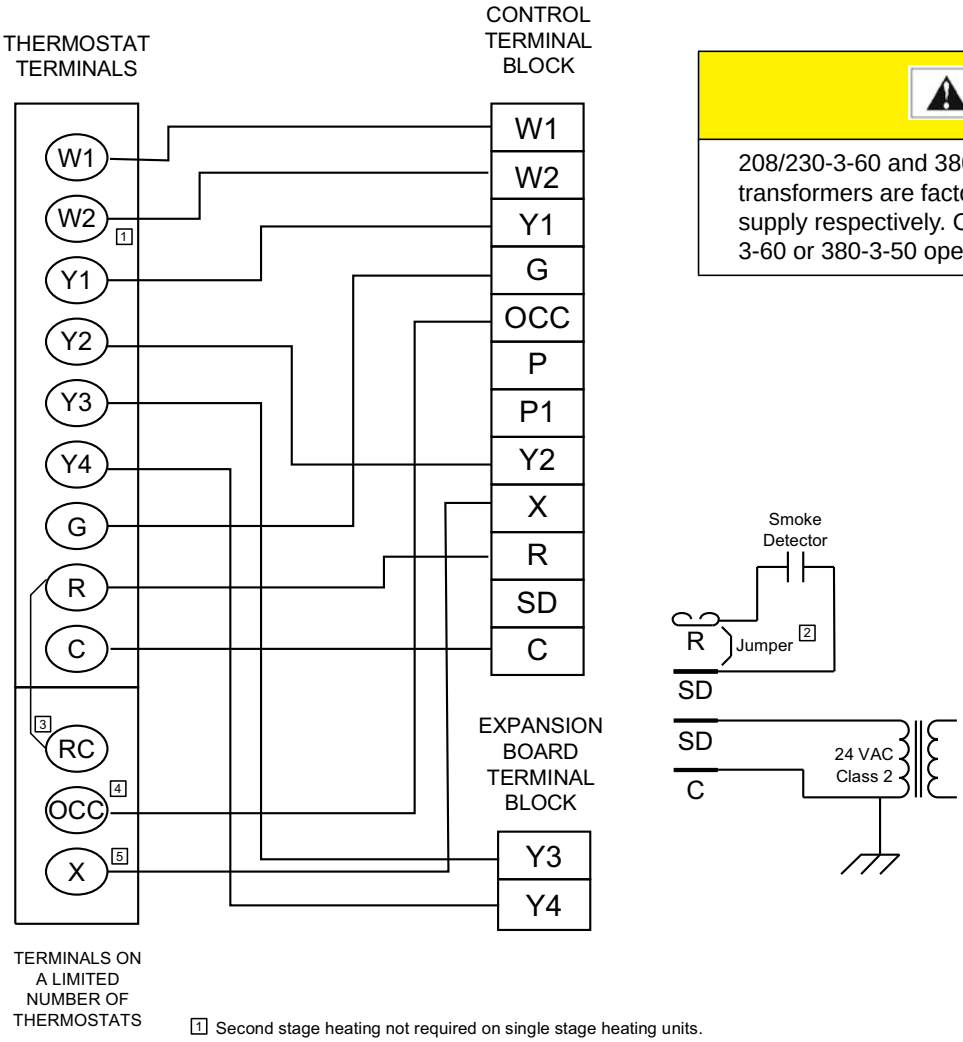
Table 7: Control Wire Sizes

Wire Size	Maximum Length[1]
18 AWG	150 Feet

1. From the unit to the thermostat and back to the unit.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.



1 Second stage heating not required on single stage heating units.

2 Jumper is required if there is no Smoke Detector circuit.

3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

5 X is an input to the thermostat to display Error Status conditions.

Figure 12: Typical Field Wiring 24 Volt Thermostat

Table 8: Electrical Data

J15 thru 25 ZJ - Standard Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	0.0	None	--	--	--	80.1	90
								E18	13.5	1	37.5	80.1	90
								E36	27	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	13.1	83	20.5	2.1	14.4	0.0	None	--	--	--	78.8	90
								E18	18.0	1	43.3	78.8	90
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	6.1	41	9.5	1.1	7.2	0.0	None	--	--	--	37.8	45
								E18	18.0	1	21.7	37.8	45
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	4.4	33	6.8	0.9	5.9	0.0	None	--	--	--	28.6	30
								E18	18.0	1	17.3	29.0	30
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	15.4	0.0	None	-	-	-	106.3	110
								E18	13.5	1	37.5	106.3	110
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	17.9	120	28.0	3.7	14.4	0.0	None	-	-	-	105.3	110
								E18	18.0	1	43.3	105.3	110
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	9.6	70	15.0	1.9	7.2	0.0	None	-	-	-	55.6	60
								E18	18.0	1	21.7	55.6	60
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	7.4	53	11.5	1.5	5.9	0.0	None	-	-	-	43.4	50
								E18	18.0	1	17.3	43.4	50
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90

J15 thru 25 ZJ - Standard Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	28.0	0.0	None	--	--	--	139.4	150
								E18	13.5	1	37.5	139.4	150
								E36	27.0	2	74.9	139.4	150
								E54	40.6	2	112.7	175.9	200
								E72	54.1	2	150.2	185.2	200
	230-3-60	22.4	149	35.0	3.7	26.0	0.0	None	--	--	--	136.9	150
								E18	18.0	1	43.3	136.9	150
								E36	36.0	2	86.6	140.8	150
								E54	54.0	2	129.9	162.4	175
								E72	72.0	2	173.2	205.7	225
	460-3-60	10.6	75	16.5	1.9	13.0	0.0	None	--	--	--	66.3	70
								E18	18.0	1	21.7	66.3	70
								E36	36.0	2	43.3	70.4	80
								E54	54.0	2	65.0	81.2	90
								E72	72.0	2	86.6	102.9	110
	575-3-60	7.7	54	12.0	1.5	10.3	0.0	None	--	--	--	49.7	50
								E18	18.0	1	17.3	49.7	50
								E36	36.0	2	34.6	56.2	60
								E54	54.0	2	52.0	64.8	70
								E72	72.0	2	69.3	82.2	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J15 thru 25 ZJ - Standard Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	10.0	None	--	--	--	90.1	100
								E18	13.5	1	37.5	90.1	100
								E36	27	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	13.1	83	20.5	2.1	14.4	10.0	None	--	--	--	88.8	100
								E18	18.0	1	43.3	88.8	100
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	6.1	41	9.5	1.1	7.2	5.0	None	--	--	--	42.8	50
								E18	18.0	1	21.7	42.8	50
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	4.4	33	6.8	0.9	5.9	4.0	None	--	--	--	32.6	35
								E18	18.0	1	17.3	34.0	35
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
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	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	15.4	10.0	None	-	-	-	116.3	125
								E18	13.5	1	37.5	116.3	125
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	17.9	120	28.0	3.7	14.4	10.0	None	-	-	-	115.3	125
								E18	18.0	1	43.3	115.3	125
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	9.6	70	15.0	1.9	7.2	5.0	None	-	-	-	60.6	70
								E18	18.0	1	21.7	60.6	70
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	7.4	53	11.5	1.5	5.9	4.0	None	-	-	-	47.4	50
								E18	18.0	1	17.3	47.4	50
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90

J15 thru 25 ZJ - Standard Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	28.0	10.0	None	--	--	--	149.4	175
								E18	13.5	1	37.5	149.4	175
								E36	27.0	2	74.9	149.4	175
								E54	40.6	2	112.7	188.4	200
								E72	54.1	2	150.2	197.7	200
	230-3-60	22.4	149	35.0	3.7	26.0	10.0	None	--	--	--	146.9	150
								E18	18.0	1	43.3	146.9	150
								E36	36.0	2	86.6	153.3	175
								E54	54.0	2	129.9	174.9	175
								E72	72.0	2	173.2	218.2	225
	460-3-60	10.6	75	16.5	1.9	13.0	5.0	None	--	--	--	71.3	80
								E18	18.0	1	21.7	71.3	80
								E36	36.0	2	43.3	76.6	80
								E54	54.0	2	65.0	87.5	90
								E72	72.0	2	86.6	109.1	110
	575-3-60	7.7	54	12.0	1.5	10.3	4.0	None	--	--	--	53.7	60
								E18	18.0	1	17.3	53.7	60
								E36	36.0	2	34.6	61.2	70
								E54	54.0	2	52.0	69.8	70
								E72	72.0	2	69.3	87.2	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J15 thru 25 ZJ - High Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	0.0	None	--	--	--	80.1	90
								E18	13.5	1	37.5	80.1	90
								E36	27	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	13.1	83	20.5	2.1	14.4	0.0	None	--	--	--	78.8	90
								E18	18.0	1	43.3	78.8	90
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	6.1	41	9.5	1.1	7.2	0.0	None	--	--	--	37.8	45
								E18	18.0	1	21.7	37.8	45
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	4.4	33	6.8	0.9	5.9	0.0	None	--	--	--	28.6	30
								E18	18.0	1	17.3	29.0	30
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	20.0	0.0	None	-	-	-	111.4	125
								E18	13.5	1	37.5	111.4	125
								E36	27.0	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	17.9	120	28.0	3.7	20.0	0.0	None	-	-	-	111.4	125
								E18	18.0	1	43.3	111.4	125
								E36	36.0	2	86.6	133.3	150
								E54	54.0	2	129.9	154.9	175
								E72	72.0	2	173.2	198.2	225
	460-3-60	9.6	70	15.0	1.9	10.0	0.0	None	-	-	-	58.5	60
								E18	18.0	1	21.7	58.5	60
								E36	36.0	2	43.3	66.6	70
								E54	54.0	2	65.0	77.5	90
								E72	72.0	2	86.6	99.1	110
	575-3-60	7.4	53	11.5	1.5	8.2	0.0	None	-	-	-	45.9	50
								E18	18.0	1	17.3	45.9	50
								E36	36.0	2	34.6	53.6	60
								E54	54.0	2	52.0	62.2	70
								E72	72.0	2	69.3	79.5	90

J15 thru 25 ZJ - High Static Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	38.6	0.0	None	--	--	--	152.7	175
								E18	13.5	1	37.5	152.7	175
								E36	27.0	2	74.9	152.7	175
								E54	40.6	2	112.7	189.1	200
								E72	54.1	2	150.2	198.4	225
	230-3-60	22.4	149	35.0	3.7	38.6	0.0	None	--	--	--	152.7	175
								E18	18.0	1	43.3	152.7	175
								E36	36.0	2	86.6	156.5	175
								E54	54.0	2	129.9	178.2	200
								E72	72.0	2	173.2	221.5	250
	460-3-60	10.6	75	16.5	1.9	19.3	0.0	None	--	--	--	74.1	90
								E18	18.0	1	21.7	74.1	90
								E36	36.0	2	43.3	78.3	90
								E54	54.0	2	65.0	89.1	100
								E72	72.0	2	86.6	110.7	125
	575-3-60	7.7	54	12.0	1.5	15.4	0.0	None	--	--	--	56.1	70
								E18	18.0	1	17.3	56.1	70
								E36	36.0	2	34.6	62.6	70
								E54	54.0	2	52.0	71.2	80
								E72	72.0	2	69.3	88.5	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J15 thru 25 ZJ - High Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	10.0	None	--	--	--	90.1	100
								E18	13.5	1	37.5	90.1	100
								E36	27	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	13.1	83	20.5	2.1	14.4	10.0	None	--	--	--	88.8	100
								E18	18.0	1	43.3	88.8	100
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	6.1	41	9.5	1.1	7.2	5.0	None	--	--	--	42.8	50
								E18	18.0	1	21.7	42.8	50
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	4.4	33	6.8	0.9	5.9	4.0	None	--	--	--	32.6	35
								E18	18.0	1	17.3	34.0	35
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	20.0	10.0	None	-	-	-	121.4	125
								E18	13.5	1	37.5	121.4	125
								E36	27.0	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	17.9	120	28.0	3.7	20.0	10.0	None	-	-	-	121.4	125
								E18	18.0	1	43.3	121.4	125
								E36	36.0	2	86.6	145.8	150
								E54	54.0	2	129.9	167.4	175
								E72	72.0	2	173.2	210.7	225
	460-3-60	9.6	70	15.0	1.9	10.0	5.0	None	-	-	-	63.5	70
								E18	18.0	1	21.7	63.5	70
								E36	36.0	2	43.3	72.9	80
								E54	54.0	2	65.0	83.7	90
								E72	72.0	2	86.6	105.4	110
	575-3-60	7.4	53	11.5	1.5	8.2	4.0	None	-	-	-	49.9	50
								E18	18.0	1	17.3	49.9	50
								E36	36.0	2	34.6	58.6	60
								E54	54.0	2	52.0	67.2	70
								E72	72.0	2	69.3	84.5	90

J15 thru 25 ZJ - High Static Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	38.6	10.0	None	--	--	--	162.7	200
								E18	13.5	1	37.5	162.7	200
								E36	27.0	2	74.9	162.7	200
								E54	40.6	2	112.7	201.6	225
								E72	54.1	2	150.2	210.9	225
	230-3-60	22.4	149	35.0	3.7	38.6	10.0	None	--	--	--	162.7	200
								E18	18.0	1	43.3	162.7	200
								E36	36.0	2	86.6	169.0	200
								E54	54.0	2	129.9	190.7	225
								E72	72.0	2	173.2	234.0	250
	460-3-60	10.6	75	16.5	1.9	19.3	5.0	None	--	--	--	79.1	90
								E18	18.0	1	21.7	79.1	90
								E36	36.0	2	43.3	84.5	90
								E54	54.0	2	65.0	95.3	110
								E72	72.0	2	86.6	117.0	125
	575-3-60	7.7	54	12.0	1.5	15.4	4.0	None	--	--	--	60.1	70
								E18	18.0	1	17.3	60.1	70
								E36	36.0	2	34.6	67.6	70
								E54	54.0	2	52.0	76.2	90
								E72	72.0	2	69.3	93.5	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J25ZJ - Low Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	20.0	0.0	None	--	--	--	130.0	150
								E18	13.5	1	37.5	130.0	150
								E36	27.0	2	74.9	130.0	150
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	22.4	149	35.0	3.7	20.0	0.0	None	--	--	--	130.0	150
								E18	18.0	1	43.3	130.0	150
								E36	36.0	2	86.6	133.3	150
								E54	54.0	2	129.9	154.9	175
								E72	72.0	2	173.2	198.2	225
	460-3-60	10.6	75	16.5	1.9	10.0	0.0	None	--	--	--	62.7	70
								E18	18.0	1	21.7	62.7	70
								E36	36.0	2	43.3	66.6	70
								E54	54.0	2	65.0	77.5	90
								E72	72.0	2	86.6	99.1	110
	575-3-60	7.7	54	12.0	1.5	8.2	0.0	None	--	--	--	47.1	50
								E18	18.0	1	17.3	47.1	50
								E36	36.0	2	34.6	53.6	60
								E54	54.0	2	52.0	62.2	70
								E72	72.0	2	69.3	79.5	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J25ZJ - Low Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	20.0	10.0	None	--	--	--	140.0	150
								E18	13.5	1	37.5	140.0	150
								E36	27.0	2	74.9	140.0	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	22.4	149	35.0	3.7	20.0	10.0	None	--	--	--	140.0	150
								E18	18.0	1	43.3	140.0	150
								E36	36.0	2	86.6	145.8	150
								E54	54.0	2	129.9	167.4	175
								E72	72.0	2	173.2	210.7	225
	460-3-60	10.6	75	16.5	1.9	10.0	5.0	None	--	--	--	67.7	70
								E18	18.0	1	21.7	67.7	70
								E36	36.0	2	43.3	72.9	80
								E54	54.0	2	65.0	83.7	90
								E72	72.0	2	86.6	105.4	110
	575-3-60	7.7	54	12.0	1.5	8.2	4.0	None	--	--	--	51.1	60
								E18	18.0	1	17.3	51.1	60
								E36	36.0	2	34.6	58.6	60
								E54	54.0	2	52.0	67.2	70
								E72	72.0	2	69.3	84.5	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Table 9: J15 thru 25 ZJ Physical Data

Component	Models							
	J15ZJ		J18ZJ		J20ZJ		J25ZJ	
Nominal Tonnage	**15**		**17.5**		**20**		**25**	
AHRI COOLING PERFORMANCE								
Gross Capacity @ AHRI A point (Btu)	181400		TBD		242000		290000	
AHRI net capacity (Btu)	172000		TBD		235000		280000	
EER	12.2		TBD		11.5		10.5	
SEER	-		TBD		-		-	
IEER	12.3		TBD		13.0		10.6	
Nominal CFM	4500		TBD		6200		7000	
System power (KW)	14.10		TBD		20.10		26.67	
Refrigerant type	R-410a		TBD		R-410a		R-410a	
Refrigerant charge (lb-oz)								
System 1	12-0		TBD		12-0		12-4	
System 2	11-12		TBD		12-0		12-8	
System 3	12-4		TBD		12-0		12-8	
System 4	13-8		TBD		12-0		12-8	
AHRI HEATING PERFORMANCE								
Heating model	24	32	TBD	TBD	24	32	24	32
Heat input (K Btu)	300	400	TBD	TBD	300	400	300	400
Heat output (K Btu)	240	320	TBD	TBD	240	320	240	320
AFUE%	-	-	TBD	TBD	-	-	-	-
Steady state efficiency (%)	80	80	TBD	TBD	80	80	80	80
No. burners	6	8	TBD	TBD	6	8	6	8
No. stages	2	2	TBD	TBD	2	2	2	2
Temperature Rise Range (ºF)	20-50	30-60	TBD	TBD	20-50	30-60	20-50	30-60
Gas Limit Setting (ºF)	195	195	TBD	TBD	195	195	195	195
Gas piping connection (in.)	1	1	TBD	TBD	1	1	1	1
DIMENSIONS (inches)								
Length	180-19/32							
Width	92							
Height	52-5/8							
OPERATING WT. (lbs.)	2609		TBD		2697		2783	
COMPRESSORS								
Type	Scroll		TBD		Scroll		Scroll	
Quantity	4		TBD		4		4	
Unit Capacity Steps (%)	25 / 50 / 75 / 100		TBD		25 / 50 / 75 / 100		25 / 50 / 75 / 100	
CONDENSER COIL DATA								
Face area (Sq. Ft.)	63.8		TBD		63.8		63.8	
Rows	2		TBD		2		2	
Fins per inch	20		TBD		20		20	
Tube diameter (in.)	3/8		TBD		3/8		3/8	
Circuitry Type	Split-face		TBD		Split-face		Split-face	
EVAPORATOR COIL DATA								
Face area (Sq. Ft.)	25		TBD		25		25	
Rows	4		TBD		4		4	
Fins per inch	13.5		TBD		13.5		13.5	
Tube diameter	3/8		TBD		3/8		3/8	
Circuitry Type	Split-face		TBD		Split-face		Split-face	
Refrigerant control	TXV		TBD		TXV		TXV	

Table 9: J15 thru 25 ZJ Physical Data (Continued)

Component	Models								
	J15ZJ		J18ZJ		J20ZJ		J25ZJ		
Nominal Tonnage	15		17.5		20		25		
CONDENSER FAN DATA									
Quantity	4		TBD		4		4		
Fan diameter (Inch)	24		TBD		30		30		
Type	Prop		TBD		Prop		Prop		
Drive type	Direct		TBD		Direct		Direct		
No. speeds	1		TBD		1		1		
Number of motors	4		TBD		4		4		
Motor HP each	1/3		TBD		1/3		1/3		
RPM	850		TBD		870		870		
Nominal total CFM	4000		TBD		5000		5000		
BELT DRIVE EVAP FAN DATA									
Quantity	1		TBD		1		1		
Fan Size (Inch)	15 X 15		TBD		18 X 15		18 X 15		
Type	Centrifugal		TBD		Centrifugal		Centrifugal		
Motor Sheave	1VP65	1VP65	TBD	TBD	1VP60	1VP60	1VP60	1VP75X	1VP75X
Blower Sheave	BK110	BK090	TBD	TBD	BK110	BK090	1B5V94	1B5V110	1B5V94
Belt	BX85	BX81	TBD	TBD	BX78	BX75	BX78	5VX840	5VX860
Motor HP each	5	5	TBD	TBD	5	7.5	7.5	10	15
RPM	1725	1725	TBD	TBD	1725	1725	1725	1725	1725
Frame size	184T	184T	TBD	TBD	184T	213T	213T	215T	254T
FILTERS									
Quantity - Size	12 - (12 x 24 x 2)[1,2]		TBD		12 - (12 x 24 x 2)[1,2]		12 - (12 x 24 x 2)[1,2]		
	2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[3]		TBD		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[3]		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[3]		

1. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
2. 2 In. Pleated, Optional, MERV 7.
3. 4 In. Pleated, Optional, MERV 13.

Optional Electric Heat

The factory-installed heaters are wired for single point power supply. Power supply need only be brought into the single point terminal block.

These CSA approved heaters are located within the central compartment of the unit with the heater elements extending in to the supply air chamber.

Fuses are supplied, where required, by the factory. Some kW sizes require fuses and others do not. refer to Table 10 for minimum CFM limitations and to Table 8 for electrical data.

Table 10: Electric Heat Minimum Supply Air

Size (Tons)	Voltage	Minimum Supply Air (CFM)			
		Heater kW			
		9	18	54	72
J15ZJ (15)	208/230-3-60	4500	4500	5000	5000
	460-3-60	4500	4500	5000	4500
	600-3-60	4500	4500	4500	4500
J18ZJ (17.5)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
J20ZJ (20)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
J25ZJ (25)	208/230-3-60	7500	7500	7500	7500
	460-3-60	7500	7500	7500	7500
	600-3-60	7500	7500	7500	7500

Optional Gas Heat

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot.

Table 11: Gas Application Data

Unit		Input (MBH)	Output (MBH)	Temp Rise (°F)[1]
Size	Opt.			
J15ZJ	24	300	240	20-50
	32	400	320	30-60
J18ZJ	24	300	240	20-50
	32	400	320	30-60
J20ZJ	24	300	240	20-50
	32	400	320	30-60
J25ZJ	24	300	240	20-50
	32	400	320	30-60

1. On VAV units, individual VAV boxes must be full open in heating mode to insure airflow falls within temperature rise range.

Gas Piping

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas and the length of run. “National Fuel Gas Code” Z223.1 (in U.S.A.) or the current Gas Installation Codes CSA-B149.1 (in Canada) should be followed in all cases unless superseded by local codes or gas utility requirements. Refer to the Pipe Sizing Table 12. The heating value of the gas may differ with locality. The value should be checked with the local gas utility.

NOTE: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a one-inch pipe connection at the entrance fitting.

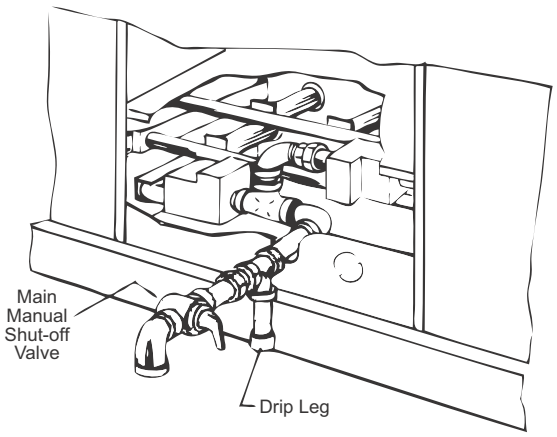

Figure 13: External Supply Connection External Shut-Off

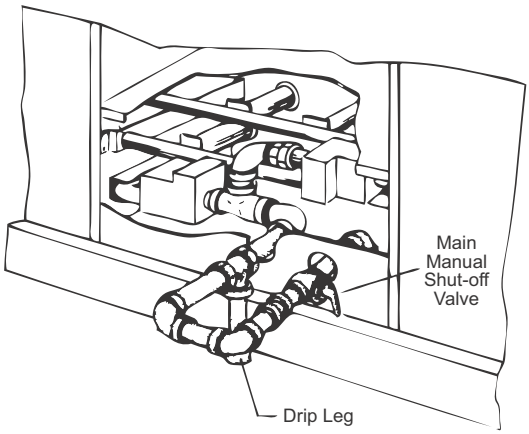

Figure 14: Bottom Supply Connection External Shut-Off

Table 12: Gas Pipe Sizing - Capacity of Pipe

Length of Pipe (ft.)	Nominal Iron Pipe Size	
	1 in.	1-1/4 in.
10	520	1050
20	350	730
30	285	590
40	245	500
50	215	440
60	195	400
70	180	370
80	170	350
90	160	320
100	150	305

NOTE: Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 inch W.C. and 0.6 specific gravity gas.

Table 13: Gas Heat Minimum Supply Air

Size (Tons)	Heat Size	Supply Air (CFM)			
		Cooling		Heating	
		Min	Max	Min	Max
J15ZJ	24	4500	7000	4500	7000
(15)	32	4500	7000	4500	7000
J18ZJ	24	6000	8750	6000	8750
(17.5)	32	6000	8750	6000	8750
J20ZJ	24	6000	9400	6000	9400
(20)	32	6000	9400	6000	9400
J25ZJ	24	7500	12500	7500	12500
(25)	32	7500	12500	7500	12500

Gas Connection

The gas supply line can be routed within the space and roof curb, exiting through the unit's basepan. Refer to Figure 5 for the gas piping inlet location. Typical supply piping arrangements are shown in Figures 13 and 14. All pipe nipples, fittings, and the gas cock are field supplied.

Gas piping recommendations:

1. A drip leg and a ground joint union must be installed in the gas piping.
2. Where required by local codes, a manual shut-off valve must be installed outside of the unit.
3. Use wrought iron or steel pipe for all gas lines. Pipe dope should be applied sparingly to male threads only.

⚠WARNING

Natural gas may contain some propane. Propane is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe. Shellac based compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clydes's or John Crane may be used.

4. All piping should be cleaned of dirt and scale by hammering on the outside of the pipe and blowing out loose particles. Before initial start-up, be sure that all gas lines external to the unit have been purged of air.
5. The gas supply should be a separate line and installed in accordance with all safety codes as prescribed under "Limitations".
6. A 1/8-inch NPT plugged tapping, accessible for test gage connection, must be installed immediately upstream of the gas supply connection to the unit.
7. After the gas connections have been completed, open the main shut-off valve admitting *normal gas pressure* to the mains. *Check all joints for leaks with soap solution or other material suitable for the purpose.* **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

⚠CAUTION

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

⚠WARNING

Threaded joints should be coated with a sealing compound that is resistant to the action of liquefied petroleum gases. **Do not use Teflon tape.**

Lp Units, Tanks And Piping

All gas heat units are shipped from the factory equipped for natural gas use only. The unit may be converted in the field for use with LP gas with accessory kit model number 1NP0418.

All LP gas equipment must conform to the safety standards of the National Fire Protection Association.

For satisfactory operation, LP gas pressure must be 10.0 inch W.C. at the unit under full load. Maintaining proper gas pressure depends on three main factors:

1. The vaporization rate which depends on the temperature of the liquid and the "wetted surface" area of the container(s).
2. The proper pressure regulation. (Two-stage regulation is recommended).
3. The pressure drop in the lines between regulators and between the second stage regulator and the appliance. Pipe size required will depend on the length of the pipe run and the total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and LP gas suppliers.

⚠WARNING

LP gas is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe for LP. Shellac base compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clyde's, or John Crane may be used.

Check all connections for leaks when piping is completed using a soap solution. **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Vent And Combustion Air

Two vent hoods and a combustion air hood (with screens) are shipped attached to the blower housing in the blower compartment. For units with factory installed VFD option, the hoods and accompanying hardware are shipped inside the gas heat section. These hoods must be installed to assure proper unit function. All hoods must be fastened to the outside of the gas heat access panel with the screws provided in the bag also attached to the blower housing.

The screen for the combustion air intake hood is secured to the inside of the access panel opening with four fasteners and the screws used for mounting the hood to the panel. The top flange of this hood slips in under the top of the access panel opening when installing. Refer to Vent and Combustion Air Hood Figure 15.

Each vent hood is installed by inserting the top flange of the hood into the slotted opening in the access panel and securing in place.

The products of combustion are discharged horizontally through these two screened, hooded vent openings on the upper gas heat access panel.

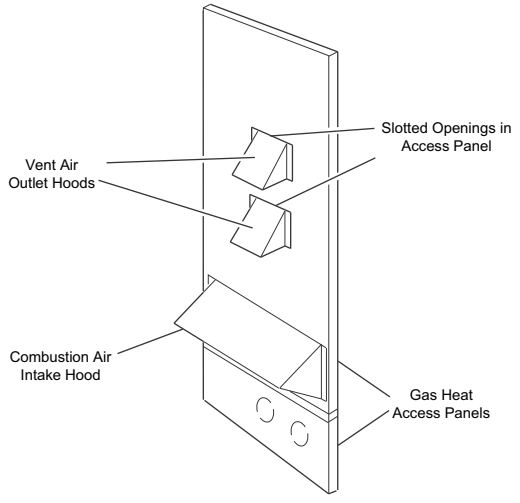

Figure 15: Vent and Combustion Air Hood

Options/Accessories

Electric Heat

Electric heaters are available as a factory-installed option. These heaters mount in the heat compartment with the heating elements extending into the supply air chamber. All electric heaters are fused and intended for use with single point power supply.

Economizer/Motorized Outdoor Damper Rain Hood

The instruction for the optional economizer/motorized damper rain hood can be found in the rain hood kit. Use these instructions when field assembling an economizer rain hood onto a unit. The outdoor and return air dampers, the damper actuator, the damper linkage, the outdoor and return air divider baffles, and all the control sensors are factory mounted as part of the “Factory installed” economizer option.

Power Exhaust/Barometric Relief Damper and Rain Hood

The instructions for the power exhaust/barometric relief damper and rain hood can be found in the rain hood kit. The exhaust fan, all supporting brackets, angles, and the wiring are factory installed as part of the power exhaust option.

Economizer And Power Exhaust Set Point Adjustments

Remove the top rear access panel from the unit. Locate the economizer control module, where the following adjustments will be made.

⚠ CAUTION

Extreme care must be exercised in turning all set point, maximum and minimum damper positioning adjustment screws to prevent twisting them off.

Minimum Position Adjustment

- Check that the damper blades move smoothly without binding; carefully turn the Minimum Position Adjust screw (found on the damper control module) fully clockwise and then set the thermostat indoor fan switch to the ON position and then OFF or energize and de-energize terminals “R” to “G”.
- With the thermostat set to the indoor fan ON position or terminals “R” to “G” energized, turn the Minimum Position Adjusting screw (located on the damper control module) counterclockwise until the desired minimum damper position has been attained.

Enthalpy Set Point Adjustment

- The enthalpy set point may now be set by selecting the desired set point shown in the Enthalpy Set Point Adjustment Figure 16. Adjust as follows:
- For a single enthalpy operation carefully turn the set point adjusting screw (found on the damper control

module) to the “A”, “B”, “C” or “D” setting corresponding to the lettered curve of the Enthalpy Set Point Adjustment Figure 17.

- For a dual enthalpy operation, carefully turn the set point adjusting screw fully clockwise past the "D" setting.

Power Exhaust Damper Set Point

With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer damper position (Percent Open). The Exhaust Air Adjustment Screw should be set at the Percent Open of the economizer damper at which the power exhaust is needed. It can be set from 0 to 100% damper open.

Indoor Air Quality AQ

Indoor Air Quality (indoor sensor input): Terminal AQ accepts a +2 to +10 Vdc signal with respect to the (AQ1) terminal. When the signal is below it's set point, the actuator is allowed to modulate normally in accordance with the enthalpy and mixed air sensor inputs. When the AQ signal exceeds it's set point setting and there is no call for free cooling, the actuator is proportionately modulated from the 2 to 10 Vdc signal, with 2 Vdc corresponding to full closed and 10 Vdc corresponding to full open. When there is no call for free cooling, the damper position is limited by the IAQ Max damper position setting. When the signal exceeds it's set point (Demand Control Ventilation Set Point) setting and there is a call for free cooling, the actuator modulates from the minimum position to the full open position based on the highest call from either the mixed air sensor input or the AQ voltage input.

- Optional CO_2 Space Sensor Kit Part # 2AQ04700324
- Optional CO_2 Sensor Kit Part # 2AQ04700424

Replace the top rear access panel on the unit.

Optional BAS-Ready Economizer Power Exhaust Damper Set Point Adjustment

Remove the economizer access panel from the unit. Loosen, but do not remove the two panel latches. Locate the economizer actuator, where the following adjustment can be made.

With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer's outdoor damper position. The actuator's auxiliary switch adjustment screw should be set at the damper position at which the power exhaust is needed. The adjustment screw can be set between 25 to 85 degrees open.

Replace the economizer access panel.

Optional Variable Air Volume (VAV)

A variable air volume (VAV) option using a variable frequency drive (VFD) is available for applications requiring a constant supply duct static pressure. A differential pressure transducer is used to monitor supply duct static pressure and return a speed reference signal to the VFD to control the output of the indoor blower motor.

Duct Static Pressure Transducer

A 0-5" WC pressure transducer, located in the control box compartment, is used to sense static (gauge) pressure in the supply air duct and convert this pressure measurement to a proportional 0-5 VDC electrical output.

Pressure-transmitting plastic tubing (1/4" diameter) must be field supplied and installed from the transducer to both the ductwork and to the atmosphere. Connect the tubing from the 'HIGH' pressure tap of the transducer to a static pressure tap (field supplied) in the supply duct located at a point where constant pressure is expected. To prevent an unstable signal due to air turbulence, there should be no obstructions, turns or VAV terminal boxes up- or down-stream of the sensing tube location for at least a distance of 6-10 times the duct diameter. Tubing must also be run between the 'LOW' pressure tap of the transducer and atmospheric pressure (outside of the unit).

⚠ CAUTION

Do not run plastic tubing in the supply or return air ducts as air movement could cause erroneous pressure measurements. If the tubing penetrates through the bottom of the unit be sure openings are sealed to prevent air and water leakage.

Vav Control Board

A VAV control board, located in the top-left corner of the control box, is used to convert the pressure transducer input signal into a speed reference signal that the drive uses to control the speed of the blower motor. This modulating speed reference signal is generated using an internal algorithm which continuously calculates an output value.

A brief description of the VAV board's I/O terminals that are used follows:

Inputs:

- **DUCT PRES** - a 0-5 VDC analog input provided by a factory-installed duct static pressure transducer located in the unit's control box.
- **SAT -** analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the unit's supply air compartment.
- **RAT -** analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the unit's return air compartment.
- **OAT -** analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the outdoor air compartment or mounted within the evaporator base rail for units without the installed economizer option.
- **ST -** analog input provided by field-installed space temperature sensor.

- **OH -** a 0-10 VDC analog input provided by a field-installed outdoor air relative humidity sensor for single enthalpy economizer configuration.
- **RH -** a 0-10 VDC analog input provided by a field-installed return air relative humidity sensor for dual enthalpy economizer configuration (used with OH).
- **IAQ -** a 0-10 VDC analog input provided by a field-installed carbon dioxide sensor which monitors indoor air quality (CO2 concentration) and enables call for Demand Ventilation mode for units installed with economizer option.
- **OAQ -** a 0-10 VDC analog input provided by a field-installed carbon dioxide sensor which monitors outdoor air quality (CO2 concentration) and, along with IAQ, enables call for Differential Demand Ventilation mode for units installed with economizer option.
- **APS -** a 24 VAC binary input provided by a field-installed air proving switch which monitors the pressure difference across the indoor blower.
- **PUR -** a 24 VAC binary input for building purge calls from an external source.
- **OCC -** a 24 VAC binary input used to set the building occupancy status for the control.
- **LIMIT 2 -** a 24 VAC binary input which either confirms 2nd-stage gas heat operation or receives an error signal from the variable frequency drive.

Outputs:

- **FAN -** a 2-10 VDC analog output signal sent to the VFD to modulate the speed of the indoor blower motor.
- **ECON -** a 2-10 VDC analog output signal sent to the economizer actuator to modulate position of the return air and outdoor air dampers (optional).
- **EXH ~ -** a 24 VAC binary output signal used to turn on/off the power exhaust relay (optional).
- **VAV BOX (gas/electric heat only) -** a normally open relay contact connected to a terminal block, used to drive the building's VAV boxes to full-open during heating operation.

Programmable set points:

The *duct static set point* is the pressure that the drive will maintain when operating the unit in VAV mode. The set-point is adjustable between 0" WC and 5" WC with the default setting of 1.5" WC.

The *duct static high-limit set point* is the maximum allowable duct pressure to prevent damage from over-pressurization of the ductwork in the event of either a drive or damper failure. The high-limit set-point is adjustable between 0" WC and 5" WC with the factory default setting of 4.5" WC. If the duct static pressure reaches the high-limit set point, then the supply fan motor will be shutdown.

NOTE: Either of the set points described above can be changed through the unit control board (UCB) with the use of a USB-to-RS485 converter, personal computer or PDA and a down-loaded copy of the Simplicity® software available at the UPGnet Commercial Product Catalog website.

⚠ CAUTION

The customer must be aware of the duct pressure design limit, and what the duct pressure sensor is reading when the peak pressure is reached (i.e. the pressure transducer sensing tube may not be located at the place of highest pressure in the system).

Factory-installed VFD

The factory-installed VFD is mounted in the Blower Access Compartment above the blower assembly. The drive comes wired from the factory to include both 3-phase power and control connections (run permit signal, speed reference signal & fault signal).

All required drive parameters are pre-programmed at the factory, except in the case of 208-volt applications, in which the parameter that defines motor nameplate voltage must be changed to a value of 208.00 and the parameter that defines motor-rated current must be changed to the appropriate value appearing on the motor's nameplate. Refer to the enclosed drive material or access the UPGnet Commercial Product Catalog website for instructions on changing parameter settings.

For units also equipped with gas/electric heat, a terminal block located in the unit's control box and connected to the VAV board's "VAV BOX" terminal, must be field wired to the building's VAV boxes to ensure fully open dampers during heating operation.

Manual Bypass

An optional, factory-installed manual bypass switch available with factory-installed VFD can be found in the Blower Motor Access compartment and has the following three positions:

- **DRIVE** - routes power through the VFD for modulating control of the indoor blower motor.
- **LINE** (or BYPASS) - routes power directly to the motor which provides full-speed motor operation and complete electrical isolation of the drive.
- **TEST** - routes power to the VFD but not to the motor to allow for drive programming and/or diagnostics.

If a drive failure occurs, the unit does not automatically switch to bypass mode. The LINE/DRIVE/TEST switch must be manually switched to the LINE (BYPASS) position. If there is a call for the fan, the indoor blower motor will run at full-speed while in the bypass mode.

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

⚠WARNING

Before beginning any service, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

BAS-Ready VFD

Factory-installed VFD is also available with 'BAS-ready' models. Terminal blocks are provided in the control box (in place of the VAV control board) for field wiring of a customer-installed BAS to receive 24 VAC power and to connect to the following control signals:

- a duct static pressure transducer input signal (0-5 VDC)
- an economizer actuator input signal (2-10 VDC)
- an economizer actuator output signal (2-10 VDC)
- a VFD speed reference output signal (2-10 VDC)

The use of shielded cable is recommended for the above control wiring connections.

NOTE: Factory-installed VFD is not available with factory-installed BAS options due to space limitations in the control box.

A solid-state, lock-out relay (LR) and 100-µF, 50 VDC capacitor must be field-supplied and installed to provide a means to transmit a potential fault signal back to the BAS controller. The specific relay part number required will depend upon the need for either AC-output or DC-output. See price pages for further details.

Once the appropriate relay and capacitor are obtained, install the capacitor across LR terminals '3' & '4' and make the following wiring connections:

- LR '1' to BAS controller
- LR '2' to BAS controller
- LR '3' to UCB 'X'
- LR '4' to UCB 'C'

'VFD-Ready' For Customer-installation

Units configured as 'VFD-ready' provide provisions for a customer-installed drive. The physical dimensions of VFDs can vary greatly among manufacturers, horsepower ratings and voltage requirements. Keep in mind that drive manufacturers also require various minimum clearances to allow for adequate internal cooling of the drive during operation.

The unit comes with a mounting bracket installed in the Blower Access compartment which may accommodate other vendor's drives depending on their size. In order to utilize the unit's mounting bracket, the maximum recommended drive dimensions are as follows:

For 5-hp motor applications ..... 13" H x 6" W x 7" D
For 7.5 thru 15-hp motor applications..... 13" H x 8" W x 8" D

If the drive will not fit in the allotted space, then it will need to be mounted elsewhere; either within the building on a perpendicular wall which is not subjected to excessive temperature, vibration, humidity, dust, corrosive gas, explosive gas, etc., or within an appropriate enclosure rated for outside installation to safeguard against moisture, dust and excessive heat.

The power leads to the drive (L1, L2, L3) and from the motor (T1, T2, T3) along with the respective ground wires are supplied with the unit and need to be connected after the drive is installed.

⚠ CAUTION

Do not connect AC power to the T1, T2, T3 drive terminals to prevent damage to the VFD.

A terminal block located in the control box is provided for field connection of the VFD speed reference signal (2-10 VDC) and to the normally-open, run-permit auxiliary contact. The use of shielded cable is recommended for the above control wiring connections.

For VFD-ready units also equipped with gas/electric heat, a terminal block located in the unit's control box and connected to the VAV board's "VAV BOX" terminal, must be field wired to the building's VAV boxes to ensure fully open dampers during heating operation.

Optional Hot Gas Bypass (HGBP)

To allow for low cooling load operation, a direct-acting, pressure-modulating bypass control valve installed on the system #1 discharge line is used to divert high temperature, high pressure refrigerant around the TXV in order to maintain a desired minimum evaporator pressure.

The opening pressure of the bypass valve is fully adjustable between 0 and 80 psig with a factory-setting of 60 psig. HGBP is standard on all units with VAV and optional with CV units.

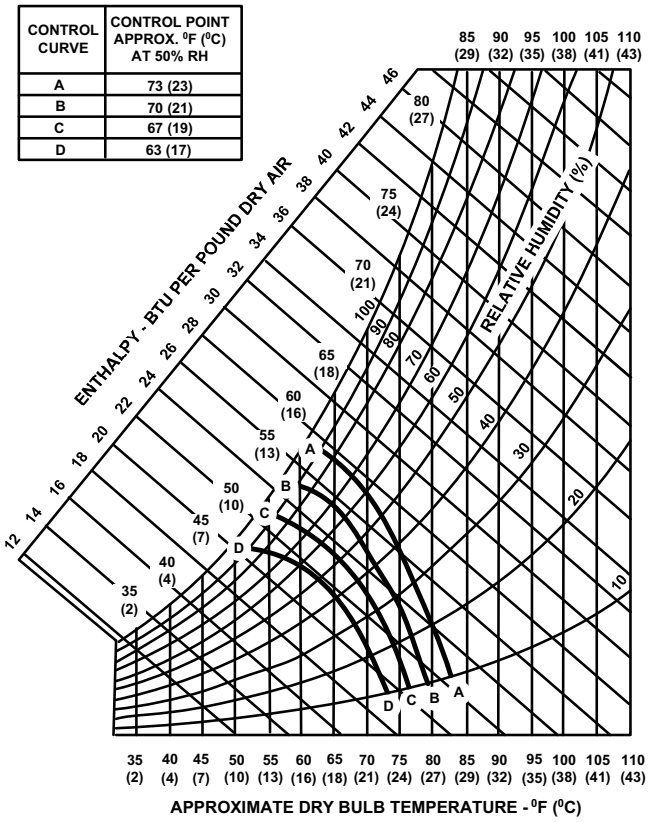
CONTROL CURVE
CONTROL POINT APPROX. °F (°C) AT 50% RH
A 73 (23)
B 70 (21)
C 67 (19)
D 63 (17)
ENTHALPY - BTU PER POUND DRY AIR
RELATIVE HUMIDITY (%)
APPROXIMATE DRY BULB TEMPERATURE - °F (°C)

Figure 16: Enthalpy Set Point Chart

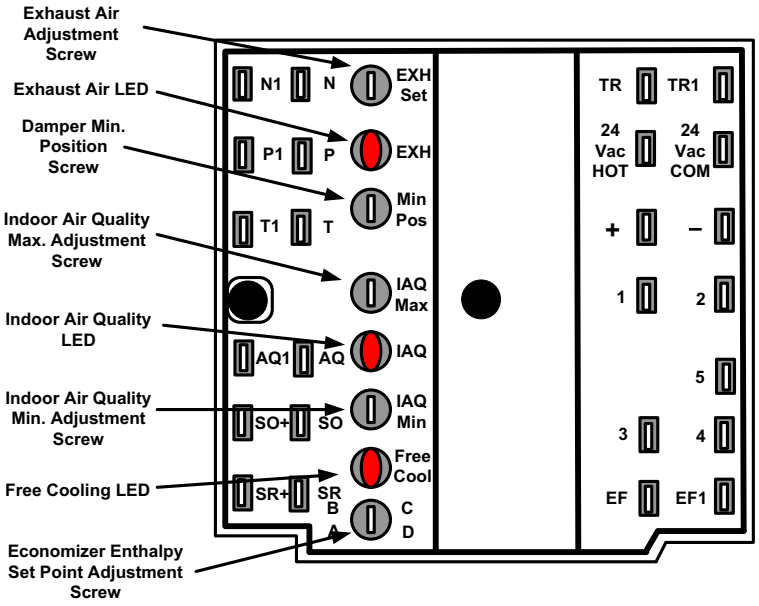

Figure 17: Economizer Control (Excludes VFD and BAS Options)

Phasing

Johnson Controls Model J**ZJ units are properly phased at the factory. Check for proper compressor rotation. If the blower or compressors rotate in the wrong direction at start-up, the electrical connection to the unit is misphased. Change the phasing of the **Field Line Connection at the factory or field supplied disconnect** to obtain proper rotation. (Scroll compressors operate in only one direction. If the scroll is drawing low amperage, has similar suction and discharge pressures, or producing a high noise level, the scroll is misphased.)

⚠ CAUTION

Scroll compressors require proper rotation to operate correctly. Units are properly phased at the factory. Do not change the internal wiring to make the blower condenser fans, or compressor rotate correctly.

Blower Rotation

Check for proper supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased (See 'PHASING').

Belt Tension

The tension on the belt should be adjusted as shown in Figure 18.

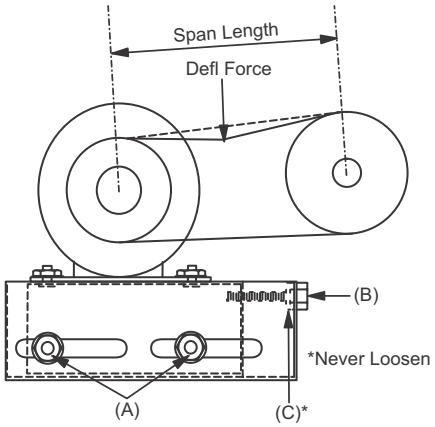

Figure 18: Belt Adjustment

⚠ CAUTION

Procedure for adjusting belt tension:

1. Loosen six nuts (top and bottom) A.
2. Adjust by turning (B).
3. Never loosen nuts (C).
4. Use belt tension checker to apply a perpendicular force to one belt at the midpoint of the span as shown. Deflection distance of 4mm (5/32") is obtained.

To determine the deflection distance from normal position, use a straight edge from sheave to sheave as reference line. The recommended deflection force is as follows:

Tension new belts at the max. deflection force recommended for the belt section. Check the belt tension at least two times during the first 24 hours of operation. Any retensioning should fall between the min. and max. deflection force values.

5. After adjusting retighten nuts (A).

CFM Static Pressure and Power-Altitude and Temperature Corrections

The information below should be used to assist in application of product when being applied at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a "constant volume" device. This means that, if the rpm remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure will be generated and less power will be required than a similar application at sea level. Air density correction factors are shown in Table 14 and Figure 19.

Table 14: Altitude/Temperature Correction Factors

Air Temp.	Altitude (Ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651

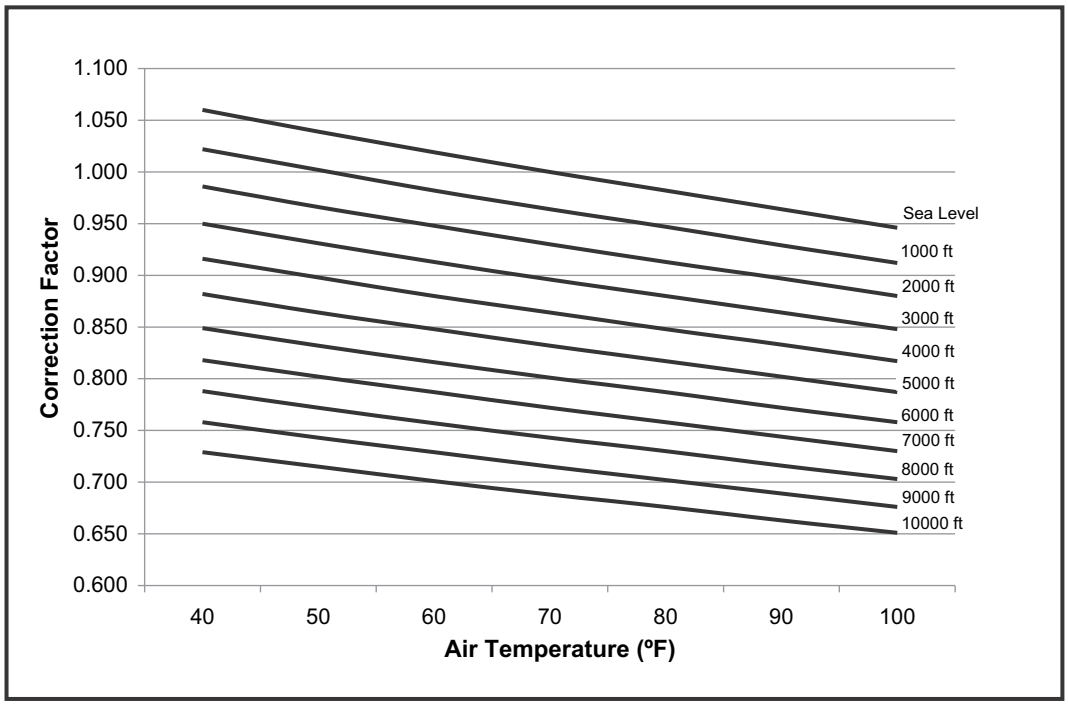

Figure 19: Altitude/Temperature Correction Factors

The examples below will assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 6,000 CFM, 1.5 IWC and 4.0 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 6,000 CFM if the rpm is unchanged. However, Table 14 must be used to determine the static pressure and BHP. Since no temperature data is given, we will assume an air temperature of 70°F. Table 14 shows the correction factor to be 0.832.

Corrected static pressure = 1.5 x 0.832 = 1.248 IWC

Corrected BHP = 4.0 x 0.832 = 3.328

Example 2: A system, located at 5,000 feet of elevation, is to deliver 6,000 CFM at a static pressure of 1.5". Use the unit blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5" static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

Sea level static pressure = 1.5 / .832 = 1.80"

Enter the blower table at 6000 sCFM and static pressure of 1.8". The rpm listed will be the same rpm needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 3.2. This value must be corrected for elevation.

BHP at 5,000 ft. = 3.2 x .832 = 2.66

Drive Selection

1. Determine side or bottom supply duct application.
2. Determine desired airflow
3. Calculate or measure the amount of external static pressure.
4. Using the operating point determined from steps 1, 2 & 3, locate this point on the appropriate supply air blower performance table. (Linear interpolation may be necessary.)
5. Noting the RPM and BHP from step 4, locate the appropriate motor and/or drive on the RPM selection table.
6. Review the BHP compared to the motor options available. Select the appropriate motor and/or drive.
7. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
8. Determine turns open to obtain the desired operation point.

Example

1. 6800 CFM
2. 2.0 iwg
3. Using the supply air blower performance table below, the following data point was located: 1020 RPM & 5.92 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 5.92 BHP exceeds the maximum continuous BHP rating of the 5.0 HP motor. The 7.5 HP motor is required.
6. 1020 RPM is within the range of the 7.5 HP drives.
7. Using the 7.5 HP motor and drive, 3.5 turns open will achieve 1020 RPM.

Example Supply Air Blower Performance

Air Flow (CFM)	Available External Static Pressure - IWG																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive										High Static 7.5 HP & Drive											
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
																					7.5 HP & Field Supplied Drive			

Table X: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
X	Y	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A

Table 15: Air Flow Performance - Side Duct Application

J15ZJ (15 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive								High Static 5 HP & Drive									
4000	727	1.14	765	1.47	806	1.77	848	2.04	891	2.29	934	2.52	977	2.73	1020	2.93	1061	3.12	1101	3.30	1138	3.48	1174	3.67
4400	753	1.51	792	1.84	832	2.14	874	2.41	917	2.66	960	2.88	1004	3.09	1046	3.29	1087	3.48	1127	3.67	1165	3.85	1200	4.03
4800	781	1.92	820	2.25	861	2.55	903	2.82	946	3.06	989	3.29	1032	3.50	1074	3.70	1116	3.89	1155	4.08	1193	4.26	1228	4.44
5200	812	2.37	850	2.70	891	3.00	933	3.27	976	3.52	1019	3.74	1062	3.95	1105	4.15	1146	4.34	1186	4.53	1223	4.71	1259	4.89
5600	844	2.86	882	3.19	923	3.49	965	3.76	1008	4.01	1051	4.23	1094	4.45	1137	4.64	1178	4.83	1218	5.02	1255	5.20	1291	5.39
6000	877	3.39	916	3.72	957	4.02	999	4.29	1042	4.54	1085	4.76	1128	4.98	1170	5.17	1212	5.36	1251	5.55	1289	5.73	-	-
6400	912	3.96	951	4.29	992	4.59	1034	4.86	1077	5.10	1120	5.33	1163	5.54	1205	5.74	-	-	-	-	-	-	-	-
6800	949	4.56	988	4.89	1028	5.19	1070	5.46	1113	5.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	986	5.20	1025	5.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

J18ZJ (17.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive										High Static 7.5 HP & Drive							
4400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J20ZJ (20 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive										High Static 7.5 HP & Drive									
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
9200	905	6.85	941	7.33	977	7.79	1014	8.22	1049	8.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	936	7.65	973	8.13	1009	8.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10000	969	8.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J25ZJ (25 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive				Low Static 7.5 HP & Drive											
6600	760	2.51	793	3.11	824	3.68	856	4.23	887	4.74	919	5.23	950	5.70	983	6.15
7000	775	2.99	808	3.60	839	4.17	871	4.71	902	5.22	934	5.72	966	6.19	998	6.64
7400	792	3.51	824	4.11	856	4.69	887	5.23	918	5.74	950	6.24	982	6.70	1014	7.16
7800	809	4.07	841	4.67	873	5.24	904	5.78	935	6.30	967	6.79	999	7.26	1031	7.71
8200	826	4.66	859	5.27	890	5.84	922	6.38	953	6.89	985	7.39	1016	7.86	1049	8.31
8600	845	5.30	877	5.90	909	6.47	940	7.01	972	7.53	1003	8.02	1035	8.49	1067	8.94
9000	864	5.97	896	6.57	928	7.14	960	7.69	991	8.20	1022	8.69	1054	9.16	1087	9.61
9400	884	6.68	916	7.28	948	7.86	980	8.40	1011	8.91	1042	9.41	1074	9.88	1107	10.33
9800	905	7.43	937	8.04	969	8.61	1000	9.15	1032	9.67	1063	10.16	1095	10.63	1127	11.08
10200	926	8.22	958	8.83	990	9.40	1021	9.94	1053	10.46	1084	10.95	1116	11.42	1148	11.87
10600	948	9.05	980	9.66	1012	10.23	1043	10.77	1075	11.29	1106	11.78	1138	12.25	1170	12.70
11000	970	9.92	1003	10.52	1034	11.09	1066	11.64	1097	12.15	1128	12.64	1160	13.11	1193	13.56
11400	993	10.82	1025	11.43	1057	12.00	1089	12.54	1120	13.06	1151	13.55	1183	14.02	1216	14.47
11800	1017	11.76	1049	12.37	1081	12.94	1112	13.48	1143	14.00	1175	14.49	1207	14.96	1239	15.41
12200	1040	12.74	1073	13.34	1104	13.91	1136	14.46	1167	14.97	1199	15.46	1231	15.93	1263	16.38
12600	1065	13.75	1097	14.35	1129	14.92	1160	15.47	1192	15.98	1223	16.47	1255	16.94	-	-
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive					
6600	1016	6.59	1050	7.00	1086	7.41	1123	7.81	1161	8.19	1202	8.58	1244	8.95	1289	9.33
7000	1031	7.07	1065	7.49	1101	7.89	1138	8.29	1176	8.68	1217	9.06	1259	9.44	1304	9.82
7400	1047	7.59	1081	8.01	1117	8.41	1154	8.81	1192	9.20	1233	9.58	1275	9.96	1320	10.34
7800	1064	8.14	1098	8.56	1134	8.97	1171	9.36	1209	9.75	1250	10.13	1292	10.51	1337	10.89
8200	1082	8.74	1116	9.16	1152	9.56	1189	9.96	1227	10.35	1268	10.73	1310	11.11	1355	11.49
8600	1101	9.37	1135	9.79	1170	10.20	1207	10.59	1246	10.98	1286	11.36	1329	11.74	1374	12.12
9000	1120	10.05	1154	10.46	1189	10.87	1226	11.27	1265	11.65	1305	12.04	1348	12.41	1393	12.79
9400	1140	10.76	1174	11.18	1209	11.58	1246	11.98	1285	12.37	1325	12.75	1368	13.13	1413	13.51
9800	1160	11.51	1195	11.93	1230	12.33	1267	12.73	1306	13.12	1346	13.50	1389	13.88	1434	14.26
10200	1182	12.30	1216	12.72	1251	13.12	1288	13.52	1327	13.91	1367	14.29	1410	14.67	1455	15.05
10600	1204	13.13	1238	13.55	1273	13.95	1310	14.35	1349	14.74	1389	15.12	1432	15.50	1477	15.88
11000	1226	14.00	1260	14.41	1296	14.82	1332	15.22	1371	15.60	1412	15.99	1454	16.36	1499	16.74
11400	1249	14.90	1283	15.32	1318	15.72	1355	16.12	1394	16.51	1434	16.89	-	-	-	-
11800	1272	15.84	1306	16.26	1342	16.66	1379	17.06	-	-	-	-	-	-	-	-
12200	1296	16.82	1330	17.23	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

Table 16: Air Flow Performance - Bottom Duct Application

J15ZJ (15 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive								High Static 5 HP & Drive											
4000	768	1.24	806	1.55	846	1.83	888	2.09	930	2.32	972	2.53	1015	2.73	1056	2.91	1097	3.09	1136	3.27	1173	3.44	1208	3.61
4400	797	1.65	835	1.96	875	2.24	916	2.49	959	2.72	1001	2.93	1043	3.13	1085	3.32	1126	3.50	1165	3.67	1202	3.84	1237	4.02
4800	828	2.09	866	2.40	906	2.68	947	2.93	989	3.16	1032	3.38	1074	3.58	1116	3.76	1157	3.94	1196	4.11	1233	4.28	1267	4.46
5200	860	2.57	898	2.88	938	3.16	980	3.41	1022	3.65	1064	3.86	1107	4.06	1148	4.24	1189	4.42	1228	4.59	1265	4.77	1300	4.94
5600	894	3.09	932	3.40	972	3.68	1014	3.93	1056	4.16	1098	4.38	1141	4.57	1182	4.76	1223	4.94	1262	5.11	1299	5.28	1334	5.46
6000	930	3.64	968	3.95	1008	4.23	1049	4.48	1091	4.71	1134	4.93	1176	5.12	1218	5.31	1259	5.49	1298	5.66	-	-	-	-
6400	966	4.22	1005	4.53	1045	4.81	1086	5.06	1128	5.30	1171	5.51	1213	5.71	-	-	-	-	-	-	-	-	-	-
6800	1005	4.84	1043	5.14	1083	5.42	1124	5.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	1044	5.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																	5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

J18ZJ (17.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive												High Static 7.5 HP & Drive							
4400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
																	7.5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J20ZJ (20 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive												High Static 7.5 HP & Drive									
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
9200	955	7.23	991	7.68	1026	8.11	1062	8.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	988	8.05	1024	8.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
															7.5 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J25ZJ (25 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]														
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	
	Low Static 7.5 HP & Field Supplied Drive		Low Static 7.5 HP & Drive												
6600	787	2.67	819	3.23	850	3.76	881	4.27	912	4.75	943	5.21	974	5.65	
7000	804	3.18	835	3.74	867	4.27	898	4.78	928	5.26	959	5.72	991	6.16	
7400	821	3.72	853	4.28	884	4.82	915	5.32	946	5.80	977	6.26	1008	6.70	Standard 10 HP & Drive
7800	839	4.30	871	4.86	902	5.40	933	5.90	964	6.39	995	6.85	1026	7.28	
8200	858	4.92	890	5.48	921	6.02	952	6.52	983	7.01	1013	7.47	1045	7.90	
8600	877	5.58	909	6.14	940	6.68	971	7.18	1002	7.66	1033	8.12	1064	8.56	
9000	898	6.28	929	6.84	960	7.37	991	7.88	1022	8.36	1053	8.82	1084	9.26	
9400	918	7.01	950	7.57	981	8.10	1012	8.61	1043	9.09	1074	9.55	1105	9.99	
9800	940	7.78	972	8.34	1003	8.87	1034	9.38	1064	9.86	1095	10.32	1127	10.76	
10200	962	8.58	994	9.14	1025	9.68	1056	10.18	1086	10.67	1117	11.13	1149	11.56	
10600	984	9.42	1016	9.98	1047	10.52	1078	11.02	1109	11.51	1140	11.96	1171	12.40	
11000	1007	10.30	1039	10.86	1070	11.39	1101	11.90	1132	12.38	1163	12.84	1194	13.28	
11400	1031	11.20	1063	11.76	1094	12.30	1125	12.80	1156	13.29	1187	13.75	1218	14.18	
11800	1055	12.14	1087	12.70	1118	13.24	1149	13.74	1180	14.23	1211	14.69	1242	15.12	
12200	1080	13.11	1111	13.68	1142	14.21	1173	14.72	1204	15.20	1235	15.66	1266	16.10	
12600	1104	14.12	1136	14.68	1167	15.21	1198	15.72	1229	16.20	1260	16.66	1291	17.10	
	High Static 15 HP & Drive														

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	1.8		2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive							
6600	1006	6.07	1039	6.48	1072	6.87	1107	7.25	1144	7.62	1182	7.98	1221	8.33	1263	8.68	1307	9.04
7000	1023	6.58	1055	6.98	1089	7.37	1124	7.75	1160	8.12	1198	8.48	1238	8.84	1280	9.19	1324	9.54
7400	1040	7.12	1072	7.53	1106	7.92	1141	8.30	1177	8.67	1215	9.03	1255	9.38	1297	9.74	1341	10.09
7800	1058	7.71	1090	8.11	1124	8.50	1159	8.88	1195	9.25	1233	9.61	1273	9.97	1315	10.32	1359	10.67
8200	1077	8.33	1109	8.73	1143	9.12	1178	9.50	1214	9.87	1252	10.23	1292	10.59	1334	10.94	1378	11.29
8600	1096	8.98	1129	9.39	1162	9.78	1197	10.16	1234	10.53	1272	10.89	1311	11.24	1353	11.60	1397	11.95
9000	1116	9.68	1149	10.08	1183	10.47	1218	10.85	1254	11.22	1292	11.58	1332	11.94	1373	12.29	1418	12.64
9400	1137	10.41	1170	10.82	1203	11.21	1238	11.59	1275	11.95	1313	12.32	1352	12.67	1394	13.02	1438	13.37
9800	1159	11.18	1191	11.59	1225	11.98	1260	12.35	1296	12.72	1334	13.09	1374	13.44	1416	13.79	1460	14.14
10200	1181	11.99	1213	12.39	1247	12.78	1282	13.16	1318	13.53	1356	13.89	1396	14.25	1438	14.60	1482	14.95
10600	1203	12.82	1236	13.23	1269	13.62	1304	14.00	1341	14.37	1379	14.73	1418	15.08	1460	15.44	1504	15.79
11000	1226	13.70	1259	14.10	1293	14.49	1327	14.87	1364	15.24	1402	15.60	1441	15.96	1483	16.31	1528	16.66
11400	1250	14.61	1282	15.01	1316	15.40	1351	15.78	1387	16.15	1425	16.51	1465	16.87	1507	17.22	-	-
11800	1274	15.55	1307	15.95	1340	16.34	1375	16.72	1411	17.09	-	-	-	-	-	-	-	-
12200	1298	16.52	1331	16.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

Table 17: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
J15 (15)	ZJ	5	5.75	1VP65	BK110	815	850	885	920	950	985	N/A
		5	5.75	1VP65	BK090	1010	1055	1095	1135	1180	1220	N/A
J18 (17.5)	ZJ	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
J20 (20)	ZJ	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
J25 (25)	ZJ	7.5	8.63	1VP60	1B5V94	810	850	885	920	960	1000	N/A
		10	11.50	1VP75X	1B5V110	975	1005	1040	1070	1100	1135	1165
		15	17.25	1VP75X	1B5V94	1140	1180	1215	1255	1290	1330	1365

Table 18: Indoor Blower Specifications

Size (Tons)	Model	Motor					Motor Sheave			Blower Sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum Dia. (in.)	Bore (in.)	Model	Datum Dia. (in.)	Bore (in.)	Model	
J15 (15)	ZJ	5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	10.4	1	BK110	BX83
		5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	8.4	1	BK090	BX81
J18 (17.5)	ZJ	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
J20 (20)	ZJ	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
J25 (25)	ZJ	7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	9.5	1 7/16	1B5V94	BX78
		10	1725	0.89	1.15	215T	5.8 - 7.0	1 3/8	1VP75X	11.1	1 7/16	1B5V110	5VX840
		15	1725	0.91	1.15	254T	6.2 - 7.4	1 5/8	1VP75X	9.5	1 7/16	1B5V94	5VX860

Table 19: Power Exhaust Specifications

Voltage	Motor			Motor			CFM @ 0.1 ESP
	HP	RPM[1]	QTY	LRA	FLA	MCA	
208/230-1-60	3/4	1075	1	7.7	5.0	6.25	5250
460-1-60	3/4	1075	1	4.1	2.2	2.75	5250
575-1-60	3/4	1050	1	2.84	1.5	1.875	5250

1. Motors are multi-tapped and factory wired for high speed.

Air Balance

⚠ CAUTION

On VAV units be certain that the VFD drive is set to maximum output, exhaust dampers are closed and individual space damper boxes are full open.

VFD units with bypass must not be in bypass mode ('LINE' position) unless all individual space dampers are full open.

Start the supply air blower motor. Adjust the resistances in both the supply and the return air duct systems to balance the air distribution throughout the conditioned space. The job specifications may require that this balancing be done by someone other than the equipment installer.

To check the supply air CFM after the initial balancing has been completed:

1. Remove the two 5/16" dot plugs from the blower motor and the filter access panels shown in the Unit Dimensions and Rear View Clearances Figure 6.
2. Insert at least 8" of 1/4 inch tubing into each of these holes for sufficient penetration into the air flow on both sides of the indoor coil.

NOTE: The tubes must be inserted and held in a position perpendicular to the air flow so that velocity pressure will not affect the static pressure readings.

3. Using an inclined manometer, determine the pressure drop across a dry evaporator coil. Since the moisture on an evaporator coil may vary greatly, measuring the pressure drop across a wet coil under field conditions would be inaccurate. To assure a dry coil, the compressors should be deactivated while the test is being run.

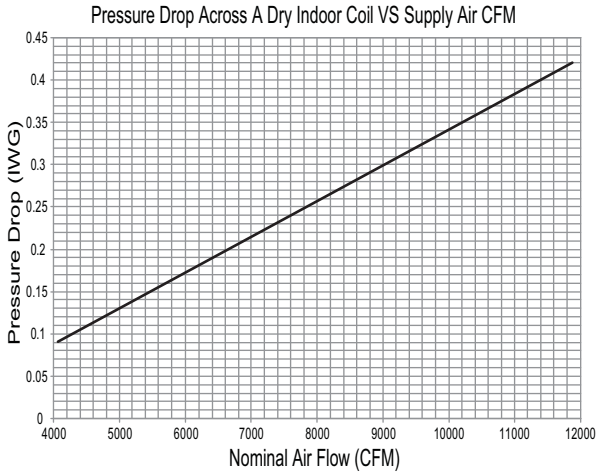

Figure 20: Pressure Drop Across A Dry Indoor Coil Vs. Supply Air CFM For All Unit Tonnages

4. Knowing the pressure drop across a dry coil, the actual CFM through the unit can be determined from the curve in Pressure Drop vs. Supply Air CFM Figure 20.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

After readings have been obtained, remove the tubes and reinstall the two 5/16" dot plugs that were removed in Step 1.

NOTE: De-energize the compressors before taking any test measurements to assure a dry indoor coil.

Supply Air Drive Adjustment

The RPM of the supply air blower will depend on the required CFM, the unit accessories or options and the static resistances of both the supply and the return air duct systems. With this information, the RPM for the supply air blower and the motor pulley adjustment (turns open) can be determined from the Blower Performance Data Tables.

⚠ CAUTION

Belt drive blower systems MUST be adjusted to the specific static and CFM requirements for the application. The belt drive blowers are NOT set at the factory for any specific static or CFM. Adjustments of the blower speed and belt tension are REQUIRED. Tighten blower pulley and motor sheave set screws after these adjustments. Re-checking set screws after 10-12 hours run time is recommended.

High speed drive accessories (containing a smaller blower pulley and a shorter belt) are available for applications requiring the supply air blower to produce higher CFM's and/or higher static pressures. Use Model 1LD0460 for 15 ton units, Model 1LD0417 for 17.5 and 20 ton units, and Model 1LD0435 for 25 ton units. Refer to the Blower Motor and Drive Data Table 18.

Note the following:

1. The supply air CFM must be within the limitations shown in the Blower Performance Tables 15 and 16.
2. Pulleys can be adjusted in half turn increments.
3. The tension on the belt should be adjusted as shown in the Bet Adjustment, Figure 18.
4. Tighten blower pulley and motor sheave set screws after any adjustments. Re-check set screws after 10-12 hours run time recommended.

Additional Static Resistance

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	Electric Heat kW[2]			
					18	36	54	72
J15 (15)	ZJ	4500	0.10	0.10	0.10	0.10	0.20	0.20
		6000	0.10	0.10	0.10	0.20	0.30	0.40
		7500	0.10	0.10	0.10	0.30	0.40	0.60
J18 (17.5) J20 (20) J25 (25)	ZJ	6000	0.10	0.10	0.10	0.10	0.20	0.20
		7500	0.10	0.10	0.10	0.20	0.30	0.40
		9000	0.15	0.15	0.10	0.30	0.40	0.60
		10500	0.15	0.15	0.20	0.40	0.60	0.80
		12000	0.20	0.20	0.30	0.50	0.70	0.90

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Operation

Cooling Sequence Of Operation

For J**ZJ units, the thermostat makes a circuit between “R” and “Y1” for the first stage of cooling.

The call is passed to the **Unit Control Board (UCB),** which then determines whether the requested operation is available and, if so, which components to energize.

For gas heating, the UCB monitors the "W1" call but does not handle the operation of the gas furnace. An ignition control board controls the gas heater operation. For electric heat units, the UCB passes the call to the electric heater. In both cases, when the "W1" call is sensed, the indoor air blower is energized following a specified heating delay.

If at any time a call for both heating and cooling are present, the heating operation will be performed. If operating, the cooling system is halted as with a completion of a call for cooling. Heating always takes priority.

Continuous Blower

By setting the room thermostat fan switch to "ON," the supply air blower will operate continuously.

Intermittent Blower

With the room thermostat fan switch set to "AUTO" and the system switch set to either the "AUTO" or "HEAT" settings, the blower is energized whenever a cooling or heating operation is requested. The blower is energized after any specified delay associated with the operation.

When energized, the indoor blower has a minimum run time of 30 seconds. Additionally, the indoor blower has a delay of 10 seconds between operations.

econds between operations.

Optional VAV Startup and Control

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

For units with VFD and VAV control, the unit must first be put into the Occupied Mode to start operation. The default setting for all VAV units is 'Unoccupied', therefore the installer must add a jumper wire between terminals R - OCC on the VAV add-on board to put the unit into 'Occupied' Mode. Additionally, the unit can be switched between Unoccupied/Occupied mode through network communications with Simplicity™ PC and other BAS control systems.

Figure 21: Occupied Jumper

Once placed into the Occupied Mode, the speed of the indoor blower motor is controlled by duct static pressure. The Duct Static set point (default = 1.5") is the pressure that the VFD drive will maintain when operating the unit in VAV mode. If the duct static pressure reaches or exceeds the high-limit set-point (default = 4.5"), then the supply fan motor will be shutdown.

The Supply Air Temperature (SAT) is controlled by staging compressors on and off to satisfy the "Operating Cooling Supply Air Temp Set point". There are 3 set points that determine the resulting "Operating Cooling Supply Air Temp Set point".

1. VAV Cooling Supply Air Temp Upper Set point (default 60° F)
2. VAV Cooling Supply Air Temp Lower Set point (default 55° F)
3. VAV Supply Air Temp Reset Set point (default 72° F)

When the Return Air Temp (RAT) is above the "VAV Supply Air Temp Reset Set point" the SAT will be maintained at +/- 5 degrees of the "VAV Cooling Supply Air Temp Lower Set point".

When the Return Air Temp (RAT) is below the "VAV Supply Air Temp Reset Set point" the SAT will be maintained at +/- 5 degrees of the "VAV Cooling Supply Air Temp Upper Set point".

When the Outdoor air condition is sufficient for free cooling, the economizer will modulate to control the SAT to +/- 1 degrees of the operational set point.

The following components are needed to access the control points in the Simplicity® controller. Installation and operation guide is located on UPGNET.

1. Computer running Windows software with a standard USB port.

2. Simplicity® PC Software (**http://www.yorkupg.com/software.asp**)
3. Freenet USB adapter driver, (**http://www.yorkupg.com/software.asp**)
4. Simplicity® Freenet USB Adapter (S1-03101967000)
5. Freenet service cable (S1-02538682000)

No Outdoor Air Options

When the thermostat calls for the first stage of cooling, the low-voltage control circuit from “R” to “Y1” and “G” is completed. The UCB energizes the economizer (if installed and free cooling is available) or the first available compressor* and the condenser fans. For first stage cooling, compressor #1 is energized. If compressor #1 is unavailable, compressor #2 is energized. After completing the specified fan on delay for cooling, the UCB will energize the blower motor.

When the thermostat calls for the second stage of cooling, the low-voltage control circuit from “R” to “Y2” is completed. Compressor #2 is energized, provided it has not been locked out, and condenser fan motor #1, and condenser fan motor #2 remain energized. (If the ambient temperature is above 60ºF.)

If there is an initial call for more than one stage of cooling, the UCB will delay energizing compressors #2, #3 & #4 by 30 seconds each, depending on how many stages are called for, in order to avoid a power in-rush.

Once the thermostat has been satisfied, it will de-energize Y1, Y2, Y3 and Y4. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling.

To be available, a compressor must not be locked-out due to a high or low-pressure switch or freezestat trip and the **Anti-Short Cycle Delay (ASCD)** must have elapsed.

These units utilize a lead-lag feature that results in an equal amount of run hours on all compressors, thereby extending the life of the compressors. This feature works as follows: If the thermostat requires for more than one stage of cooling, the currently off compressor with the least number of run hours will be the next to be energized. When the thermostat requires fewer stages of cooling, the currently running compressor with the most run hours will be the first to be de-energized.

Economizer With Single Enthalpy Sensor

When the room thermostat calls for “first-stage” cooling, the low voltage control circuit from “R” to “G” and “Y1” is completed. The UCB energizes the blower motor (if the fan switch on the room thermostat is set in the “AUTO” position) and drives the economizer dampers from fully closed to their minimum position. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (previously determined), “Y1” energizes the economizer. The dampers will modulate to maintain a constant supply air temperature as monitored by the discharge air sensor. If the outdoor air enthalpy is above the set point, “Y1” energizes compressor #1.

When the thermostat calls for “second-stage” cooling, the low voltage control circuit from “R” to “Y2” is completed. The UCB energizes the first available compressor. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (i.e. first stage has energized the economizer), “Y2” will energize compressor #1. If the outdoor air is above the set point, “Y2” will energize compressor #2. If Y2 brings on compressor #1 and this condition remains for more than 20 minutes, then compressor #2 will be energized until the thermostat is satisfied.

Once the thermostat has been satisfied, it will de-energize “Y1” and “Y2”. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling, and the economizer damper goes to the closed position. If the unit is in continues fan operation, the economizer damper goes to the minimum position.

Economizer With Dual Enthalpy Sensors

The operation with the dual enthalpy sensors is identical to the single sensor except that a second enthalpy sensor is mounted in the return air. This return air sensor allows the economizer to choose between outdoor air and return air, whichever has the lowest enthalpy value, to provide maximum operating efficiency.

Economizer With Power Exhaust

A unit equipped with an economizer (single or dual enthalpy) and a power exhaust operates as specified above with one addition. The power exhaust motor is energized 45 seconds after the actuator position exceeds the exhaust fan set point on the economizer control. When the power exhaust is operating, the second stage of mechanical cooling will not operate. As always, the "R" to "G" connection provides minimum position but does not provide power exhaust operation.

Economizer With Optional VAV Or Intelli-comfort II™ Control

The position of the outside air and return air dampers are controlled through a 2-10 VDC signal from the VAV or Intelli-Comfort II™ control board. The economizer is enabled only in Occupied or Recovery mode. When the control is not powered or is in Unoccupied mode, the outside air dampers will be closed. When the supply fan is powered and there is no Y1 call, or if free-cooling is unavailable, the control opens the economizer dampers to the minimum position setting.

Free-cooling is available if the outdoor air temperature meets one of the three criteria discussed below, based upon the unit's configuration.

- **Dry Bulb:** The control refers to input from the Outside Air Temperature sensor and will allow free-cooling when the outdoor temperature is less than both the *First-Stage SAT Control* setpoint plus 5 °F, and the *Economizer OAT Enable* setpoint.
- **Single Enthalpy (optional):** A field-installed, Outdoor Air Humidity sensor is connected to the control. When the measured outdoor enthalpy is below the *Outside Air Enthalpy* setpoint, and the outdoor temperature is less than the *First-Stage SAT Control* setpoint plus 5 °F, free-cooling is available.
- **Dual Enthalpy (optional):** Both the field-installed Outdoor Air Humidity and the Return Air Humidity sensors are connected to the control. When the measured outdoor air enthalpy is less than the measured return air enthalpy, and the outdoor temperature is less than the *First-Stage SAT Control* setpoint plus 5 °F, free-cooling is available.

If free-cooling is available with a Y1 call, then the control modulates the economizer dampers to maintain the *First-Stage SAT Control* setpoint, plus or minus one degree. If free-cooling is unavailable, then 1st-stage mechanical cooling is initiated.

If at anytime the outdoor air temperature rises above the *First-Stage SAT Control* setpoint plus 5 °F, while free-cooling is available, then a Y1 call will also initiate 1st-stage mechanical cooling.

For a Y2 call, free-cooling is available based upon the criteria described above, except a *Second-Stage SAT Control* setpoint is used in the determination.

Once the call for cooling has been satisfied, it will de-energize any compressors and condenser fans, after the minimum compressor run times have been satisfied. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed.

Upon de-energizing the final compressor, the blower will continue to run with the economizer damper in its minimum position if in the Occupied mode; otherwise, the blower will stop following the elapse of the fan-off delay for cooling, and the economizer outdoor damper will close.

Economizer With Optional VAV Blower With Power Exhaust

The power exhaust motor is energized via the controller's EXH~ terminal and the ER relay, based on the position of the economizer damper parameter settings in the VAV control. Minimum run time is 10 seconds; minimum off time is 60 seconds. The outlet pressure of the power exhaust fan forces the barometric relief dampers open; gravity closes the dampers when the exhaust fan is off.

Economizer With Optional Intelli-comfort II™ With Power Exhaust

The power exhaust motor is energized via the exhaust relay based on the position of the economizer actuator's auxiliary switch adjustment screw. The adjustment screw represents the outdoor damper position at which to activate power exhaust, and can be set between 25 to 85 degrees open. The outlet pressure of the power exhaust fan forces the barometric relief dampers open; gravity closes the dampers when the exhaust fan is off.

Motorized Outdoor Air Dampers

This system operation is the same as the units with no outdoor air options with one exception. When the “R” to “G” circuit is complete, the motorized damper drives open to a position set by the thumbwheel on the damper motor. When the “R” to “G” circuit is opened, the damper spring returns fully closed.

Cooling Operation Errors

Each cooling system is monitored for operation outside of the intended parameters. Errors are handled as described below. All system errors override minimum run times for compressors.

High-Pressure Limit Switch

During cooling operation, if a high-pressure limit switch opens, the UCB will de-energize the associated compressor, initiate the ASCD (Anti-short cycle delay), and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a high-pressure switch open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (see Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Low-Pressure Limit Switch

The low-pressure limit switch is not monitored during the initial 30 seconds of a cooling system's operation. For the following 30 seconds, the UCB will monitor the low-pressure switch to ensure it closes. If the low-pressure switch fails to close after the 30-second monitoring phase, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the LPS is still open after the ASCD, the compressor will not be energized for 30 seconds. The second and third times that the UCB sees an open LPS will count towards the three occurrences that will cause a UCB lock-out.

Once the low-pressure switch has been proven (closed during the 30-second monitor period described above), the UCB will monitor the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans.

If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a low-pressure switch open three times within one hour of operation, the UCB will lock-out the associated compressor and flash a code (Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Freezestat

During cooling operation, if a freezestat opens, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a freezestat open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Low Ambient Cooling

To determine when to operate in low ambient mode, the UCB has a pair of terminals connected to a temperature-activated switch set at 45ºF. When the low ambient switch is closed and the thermostat is calling for cooling, the UCB will operate in the low ambient mode.

Low ambient mode operates the compressors in this manner: 10 minutes on, 5 minutes off. The indoor blower is operated throughout the cycle. The 5-minute off period is necessary to defrost the indoor coil.

Low ambient mode always begins with compressor operation. Compressor minimum run time may extend the minutes of compressor operation. The defrost cycle will begin immediately following the elapse of the minimum run time.

When operating in low ambient mode, the UCB will not lockout the compressors due to a freezestat trip. However, a freezestat trip will de-energize the associated compressor. If the call for cooling is still present at the end of the ASCD and the freezestat has closed, the unit will resume operation.

Safety Controls

The unit control board monitors the following inputs for each cooling system:

1. A suction line freezestat to protect against low evaporator temperatures due to a low airflow or a low return air temperature, (opens at 26 ± 5 °F and resets at 38 ± 5°F).
2. A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure, (opens at 625 ± 25 psig and resets 500 ± 25 psig).
3. A low-pressure switch to protect against loss of refrigerant charge, (opens at 50 ± 5 psig and resets at 71 ± 5 psig).

The above pressure switches are hard-soldered to the unit. The refrigeration systems are independently monitored and controlled. On any fault, only the associated system will be affected by any safety/preventive action. The other refrigerant system will continue in operation unless it is affected by the fault as well.

The unit control board monitors the temperature limit switch of electric heat units and the temperature limit switch and the gas valve of gas furnace units.

Compressor Protection

In addition to the external pressure switches, the compressors also have inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the protector will open to shut down the compressor. The UCB incorporates features to minimize compressor wear and damage. An **Anti-Short Cycle Delay (ASCD)** is utilized to prevent operation of a compressor too soon after its previous run. Additionally, a minimum run time is imposed any time a compressor is energized.

The ASCD is initiated on unit start-up and on any compressor reset or lock-out.

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Reset

Remove the call for cooling, by raising thermostat setting higher than the conditioned space temperature. This resets any pressure or freezestat flash codes.

Electric Heating Sequence Of Operations

The following sequence describes the operation of the electric heat section.

⚠ CAUTION

For units with VFD and electric heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across the heating elements.

Single-stage heating: (applies only to 18 KW heater, all other heaters MUST use a two-stage thermostat)

a. Upon a call for heat by the thermostat, the heater contactor (6M) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

Two-stage heating: (applies to all heaters except 18 KW)

a. Upon a call for first-stage heat by the thermostat, the heater contactor (6M) (6M & 7M on 72 KW, 240V) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

If the second stage of heat is required, heater contactor (7M) will be energized. Note that on the 54 KW, 240V heater, heater contactors (7M & 8M) will be energized and

on the 72 KW, 240V heater, heater contactors (8M & 9M) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

NOTE: All 240 & 480V heaters are provided with manual reset backup protection limits. These will de-energize the heaters should the primary limit fail to open or the contactors fail to open in a failure mode.

Electric Heat Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized.

This limit is monitored regardless of unit operation status, i.e. the limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and a flash code is initiated (See Table 25).

Safety Controls

The UCB monitors the temperature limit switch of electric heat units.

The control circuit includes the following safety controls:

Temperature Limit Switch (TLs)

1. Temperature Limit Switch (TLS 1, 2).

   This control is located inside the heater compartment and is set to open at the temperature indicated in the Limit Control Setting Table 20. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

2. Temperature Limit Switch (TLS 3, 4, 5 and 6).

   This control is located inside the heater compartment and is set to open at the temperature indicated in the Limit Control Setting Table 20. It is a manual reset limit. These limit switches will de-energize the heaters should the primary limit fail to open or the contactors fail to open in a failure mode.

Table 20: Limit Control Setting

Unit (Tons)	Voltage	Heater Kw	Temperature, Limit Switch 1, 2 Opens, °F	Temperature, Limit Switch 3, 4, 5, 6 Opens, °F
15	240	18	120	170
		36	120	170
		54	120	170
		72	120	170

Table 20: Limit Control Setting

Unit (Tons)	Voltage	Heater Kw	Temperature, Limit Switch 1, 2 Opens, °F	Temperature, Limit Switch 3, 4, 5, 6 Opens, °F
17.5, 20 and 25	240	18	140	200
		36	140	200
		54	140	200
		72	140	200
15, 17.5, 20 and 25	460	18	120	170
		36	120	170
		54	120	170
		72	120	170
15, 17.5, 20 and 25	600	18	120	-
		36	120	-
		54	120	-
		72	120	-

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Reset

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature.This resets any flash codes.

Electric Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter “ON” cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 21 for the required electric heat anticipator setting.

Table 21: Electric Heat Anticipator Setpoint

Heater Kw	Voltage	Setting, Amps	
		Th1	Th2
18	208/230-3-60	0.29	-
36		0.29	0.29
54		0.29	0.58
72		0.29	0.58
18	460-3-60	0.29	-
36		0.29	0.29
54		0.29	0.29
72		0.29	0.29
18	575-3-60	0.29	-
36		0.29	0.29
54		0.29	0.29
72		0.29	0.29

Gas Heating Sequence Of Operations

The following sequence describes the operation of the gas heat section.

⚠ CAUTION

For units with VFD and gas heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across the heat exchanger tubes.

When the thermostat calls for the first stage of heating, the low-voltage control circuit from “R” to “W1” and “G” is completed, thru the UCB. The heat relay “RW1” is energized. The “RW1-2” contacts close energizing the draft motor control. The draft motor control contacts close and start the draft motor. As the speed of the draft motor reaches approximately 2500 RPM, the centrifugal switch contact, located on the end of the draft motor shaft, closes to power the first stage ignition module “IC1”, thru the “RW1-1” contacts.

Ignition module “IC1” will immediately start the first stage igniter sparking and will open the redundant valve located inside the first stage main gas valve “GV1” to allow a flow of gas to only the first stage carryover tube. Only after the pilot flame has been ignited and the presence of pilot flame detected at the “IC1” by a signal sent back through the flame sensor is sparking terminated and the first stage main gas valve opened.

Gas flows into each of the main burners and is ignited from the carryover tube flame.

After completing the specified fan on delay for heating, the UCB will energize the blower motor.

If “IC1” fails to detect a pilot flame, it will continue to try for a maximum of 85 seconds to ignite the pilot tube. If the pilot flame is not detected, then “IC1” will lock out first stage furnace operation for five minutes or until 24V power is removed from the module either at the unit or by resetting the room thermostat.

When the thermostat calls for the second stage of heating, the low-voltage control circuit from “R” to “W2” is completed, thru the UCB. Heat relay “RW2” is energized. The “RW2-1” contact is closed energizing the second stage ignition module “IC2”. “IC2” will immediately start the second stage igniter sparking and will open the redundant valve located inside the second stage main gas valve “GV2” to allow a flow of gas to the second stage carryover tube. Only after the pilot flame has been ignited and the presence of pilot flame detected at “IC2” by a signal sent back through the flame sensor is sparking terminated and the main gas valve opened.

Gas flows into each of the second stage main burners and is ignited from the carryover tube flame.

If “IC2” fails to detect a pilot flame, it will continue to try for a maximum of 85 seconds to ignite the pilot tube. If the pilot flame is not detected, then “IC2” will lock out first stage furnace operation for five minutes or until 24V power is removed from the module either at the unit or by resetting the room thermostat.

NOTE: That the second stage furnace can operate even if first stage has locked out.

When the thermostat satisfies de-energizing the “RW2”and “RW1”, thus opening all gas valves. The blower motor will continue to run after the furnace is shut down until the specified fan off delay for heating has been satisfied. The UCB will de-energize the blower motor.

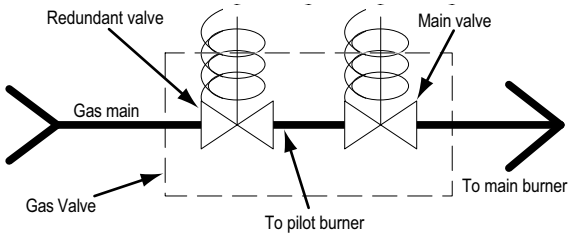

Figure 22: Gas Valve Piping

When the thermostat calls for the first stage of heating, the low-voltage control circuit from “R” to “W1” is completed. A call for heat passes through the UCB to the ignition control board (ICB). The UCB monitors the “W1” call and acts upon any call for heat. Once voltage has been sensed at “W1”, the UCB will initiate the fan on delay for heating, energizing the indoor blower after the specified delay has elapsed.

When the thermostat has been satisfied, heating calls are ceased. The GV is immediately de-energized. The blower is de-energized after the fan off delay for heating has elapsed. The draft motor performs a 25-second post purge.

Gas Heating Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized. When the UCB again senses 24 volts from the temperature limit, the draft motor will perform a 25-second post-purge and the indoor blower will be de-energized following the elapse of the fan off delay for heating.

This limit is monitored regardless of unit operation status, i.e. this limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and flash code is initiated (See Table 25).

Gas Valve

The UCB continuously monitors the GV. Any time the UCB senses voltage at the GV without a call for heat for a continuous five-minute period, the UCB will lock-on the indoor blower and a flash code is initiated (Table 25). When voltage is no longer sensed at the GV, the UCB will de-energize the indoor blower following the elapse of the fan off delay for heating.

If voltage has been sensed at the GV for at least 15 seconds during the fan on delay for heating and GV voltage or “W1” is lost, the indoor blower is forced on for the length of the fan off delay for heating.

Safety Controls

The UCB monitors the temperature limit switch of gas heat units.

The control circuit includes the following safety controls:

Limit Switch (LS)

This control is located inside the gas heat compartment and is set to open at the temperature indicated in the Gas Heat Limit Control Settings Table 22. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

Centrifugal Switch (CS)

If the draft motor should fail, the centrifugal switch attached to the shaft of the motor prevents the ignition controls and gas valves from being energized.

Redundant Gas Valve

There are two separate gas valves in the furnace. Each valve contains a main and a redundant valve. The redundant valves are located upstream of the main gas valves. Should either or both of the main gas valves fail in the open position the redundant valves serve as back-ups and shut off the flow of gas.

Flame Sensor Rod / 100% Ignition Control Lock-Out.

The flame rods and controls are located per Proper Flame Adjustment Figure 24. If an ignition control fails to detect a signal from the flame sensor indicating the pilot flame is properly ignited, then the main gas valve will not open. It will continue to try and ignite the pilot for a maximum of 85 seconds, then if the pilot flame is not detected, the ignition control will lock out furnace operation until 24V power is removed from the module either at the unit or by resetting the room thermostat.

Rollout Switch

This switch is located above the main burners in the control compartment, which in the event of a sustained main burner rollout shuts off and locks out both ignition controls closing both gas valves. The ignition controls lock out furnace operation until 24V power is removed from the controls either at the unit or by resetting the room thermostat.

Auxiliary Limit Switch (AUX)

This control is located inside the heat exchanger compartment and is set to open at 190°F. It is a manual reset switch. If AUX trips, then the primary limit has not functioned correctly. Replace the primary limit.

Table 22: Gas Heat Limit Control Setting

Units (Tons)	Capacity, MBH		Limit Control Opens, ºF
	Input	Output	
15, 17.5, 20 & 25	300	240	195
15, 17.5, 20 & 25	400	320	195

The ICB monitors the Pressure and Rollout switches of gas heat units.

The control circuit includes the following safety controls:

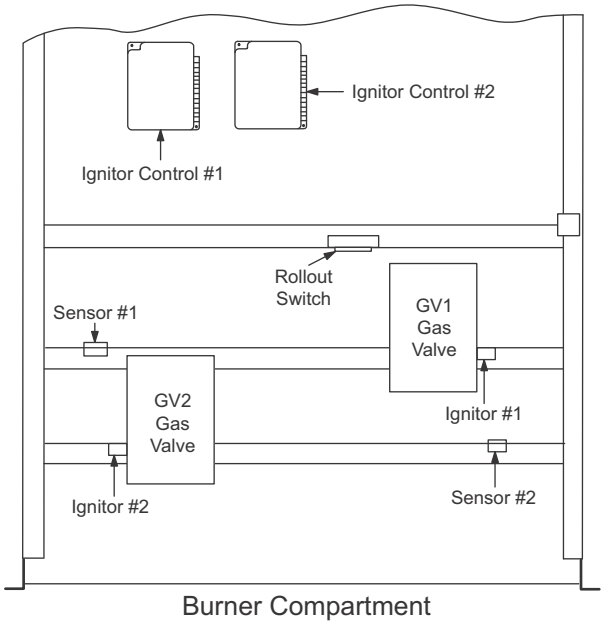

Figure 23: Gas Valve and Controls

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Resets

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature. This resets any flash codes.

Gas Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter “ON cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 23 for the required gas heat anticipator setting.

Table 23: Gas Heat Anticipator Setpoints

Gas Valve	Anticipator Setpoint	
	1st Stage	2nd Stage
VR8440 36C68	0.30 amp	0.11 amp

Start-Up (Cooling)

Prestart Check List

After installation has been completed:

1. Check the electrical supply voltage being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Set the room thermostat to the off position.
3. Turn unit electrical power on.
4. Set the room thermostat fan switch to on.
5. Check indoor blower rotation.
   - If blower rotation is in the wrong direction. Refer to Phasing Section in general information section.

   Check blower drive belt tension.
6. Check the unit supply air (CFM).
7. Measure evaporator fan motor's amp draw.
8. Set the room thermostat fan switch to off.
9. Turn unit electrical power off.

Operating Instructions

1. Turn unit electrical power on.
2. Set the room thermostat setting to lower than the room temperature.
3. First stage compressors will energize after the built-in time delay (five minutes).
4. The second stage of the thermostat will energize second stage compressor if needed.

Post Start Check List

1. Verify proper system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.
3. Measure the system amperage draw across all legs of 3 phase power wires.
4. Measure the condenser fan amperage draw.

Start-Up (Gas Heat)

Pre-Start Check List

Complete the following checks before starting the unit.

1. Check the type of gas being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Make sure that the vent and combustion hoods have been properly installed.

Operating Instructions

⚠ CAUTION

This furnace is equipped with an intermittent pilot and automatic re-ignition system. DO NOT attempt to manually light the pilot.

Lighting The Main Burners

1. Turn “OFF” electric power to unit.
2. Turn room thermostat to lowest setting.
3. Turn gas valve knob or switch to “ON” position (See Figure 26).
4. Turn “ON” electric power to unit.
5. Set room thermostat to desired temperature (If thermostat “set” temperature is above room temperature, pilot burner ignition will occur and, after an interval to prove pilot flame, main burners will ignite).

Post Start Checklist

After the entire control circuit has been energized and the heating section is operating, make the following checks:

1. Check for gas leaks in the unit piping as well as the supply piping.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

2. Check for correct manifold gas pressures. (See CHECKING GAS INPUT.)
3. Check the supply gas pressure. It must be within the limits shown on the rating nameplate. Supply pressure should be checked with all gas appliances in the building at full fire. At no time should the standby gas pressure exceed 13 in. or the operating pressure drop below 5.0 in for natural gas units. If gas pressure is outside these limits, contact the local gas utility or propane supplier for corrective action.

Shut Down

1. Set the thermostat to the lowest temperature setting.
2. Turn “OFF” all electric power to unit.
3. Open gas heat access panel.
4. Turn gas valve clockwise to “OFF” position (See Figure 26).

Checking Gas Heat Input

1. Turn off all other gas appliances connected to the gas meter.
2. With the furnace turned on, measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter usually has a 1/2 or a 1 cubic foot test dial.
3. Using the number of seconds for each revolution and the size of the test dial increment, find the cubic feet of gas consumed per hour from the Gas Rate - Cubic Feet Per Hour Table 24.

If the actual input is not within 5% of the furnace rating (with allowance being made for the permissible range of the regulator setting), replace the orifice spuds with spuds of the proper size.

NOTE: To find the Btu input, multiply the number of cubic feet of gas consumed per hour by the Btu content of the gas in your particular locality (contact your gas company for this information - it varies widely from city to city.).

Table 24: Gas Rate Cubic Feet Per Hour

Seconds for One Rev.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
4	450	900
6	300	600
8	228	450
10	180	360
12	150	300
14	129	257
16	113	225
18	100	200
20	90	180
22	82	164
24	75	150
26	69	138
28	64	129

EXAMPLE

By actual measurement, it takes 13 seconds for the hand on the 1-cubic foot dial to make a revolution with just a 300,000 Btuh furnace running. Read across to the column in the table above, headed “1 Cubic Foot”, where you will see that 278 cubic feet of gas per hour are consumed by the furnace at that rate. Multiply 278 x 1050 (the Btu rating of the gas obtained from the local gas company). The result is 292,425 Btuh, which is close to the 300,000 Btuh rating of the furnace.

Manifold Gas Pressure Adjustment

Small adjustments to the high-fire gas flow may be made by turning the pressure regulator adjusting screw on the automatic gas valve.

Adjust as follows:

1. Remove the cap on the regulator. It's located next to the push-on electrical terminals.
2. To decrease the gas pressure, turn the adjusting screw counterclockwise.
3. To increase the gas pressure, turn the adjusting screw clockwise.

NOTE: The correct manifold pressure for these furnaces is 3.65 IWG ± 0.3.

Adjustment Of Temperature Rise

The temperature rise (the difference of temperature between the return air and the heated air from the furnace) must lie within the range shown on the CSA rating plate and the data in Table 11.

After the temperature rise has been determined, the CFM can be calculated as follows:

$$\text{CFM} = \text{Btu Input} \cdot \frac{0.8}{(1.08 \cdot \Delta^\circ\text{F})}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts (about 6 feet from the furnace) where they will not be affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise (See SUPPLY AIR DRIVE ADJUSTMENT).

NOTE: Each gas heat exchanger size has a minimum allowable CFM. Below this CFM, the limit will open.

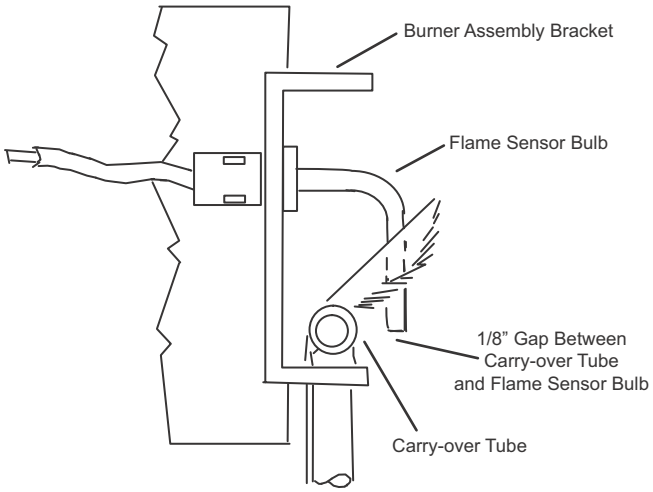

Figure 24: Proper Pilot Flame Adjustment

Pilot Checkout

The pilot flame should envelope the end of the flame sensor. To adjust pilot flame, (1) remove pilot adjustment cover screw, (2) increase or decrease the clearance for air to the desired level, (3) be sure to replace cover screw after adjustment to prevent possible gas leakage.

Put the system into operation and observe through complete cycle to be sure all controls function properly.

Burner Instruction

To check or change burners, pilot or orifices, CLOSE MAIN MANUAL SHUT-OFF VALVE AND SHUT OFF ALL ELECTRIC POWER TO THE UNIT.

1. Remove the screws holding either end of the manifold to the burner supports.
2. Open the union fitting in the gas supply line just upstream of the unit gas valve and downstream from the main manual shut-off valve.
3. Remove the gas piping closure panel.
4. Disconnect wiring to the gas valves and spark ignitors. Remove the manifold-burner gas valve assembly by lifting up and pulling back.

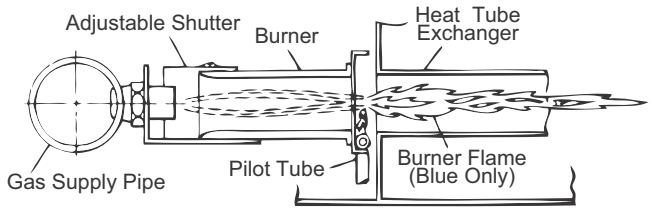

Figure 25: Typical Flame

Burners are now accessible for service.

Reverse the above procedure to replace the assemblies. Make sure that burners are level and seat at the rear of the heat exchanger.

Burner Air Shutter Adjustment

Adjust burner shutters so no yellow flame is observed in the heat exchanger tubes.

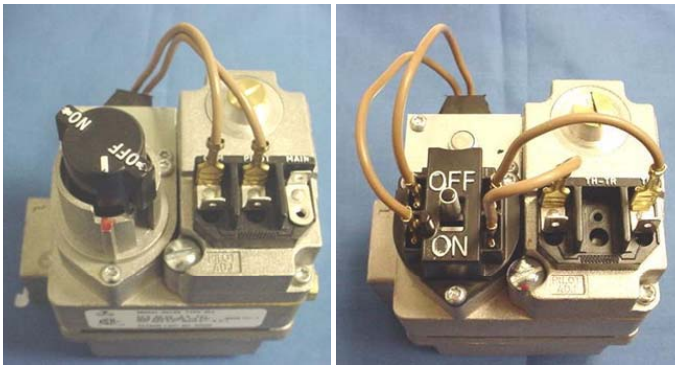

Figure 26: Typical Gas Valve

Charging The Unit

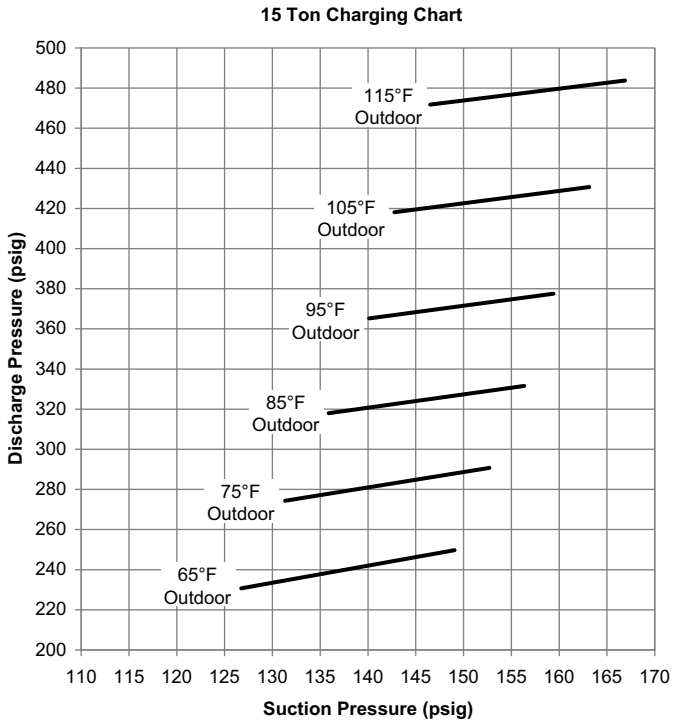

Figure 27: J15ZJ (15 Ton) Charging Chart

Figure 28: J18ZJ (17.5 Ton) Charging Chart

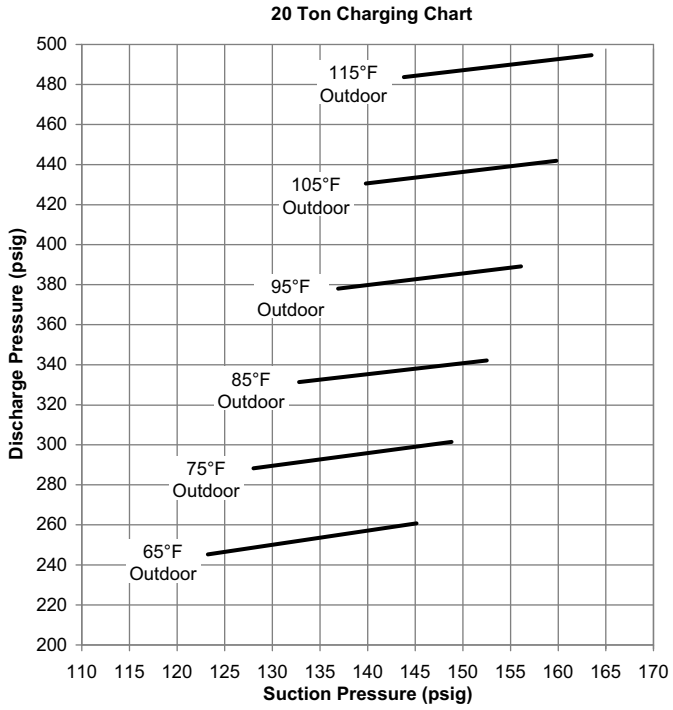

Figure 29: J20ZJ (20 Ton) Charging Chart

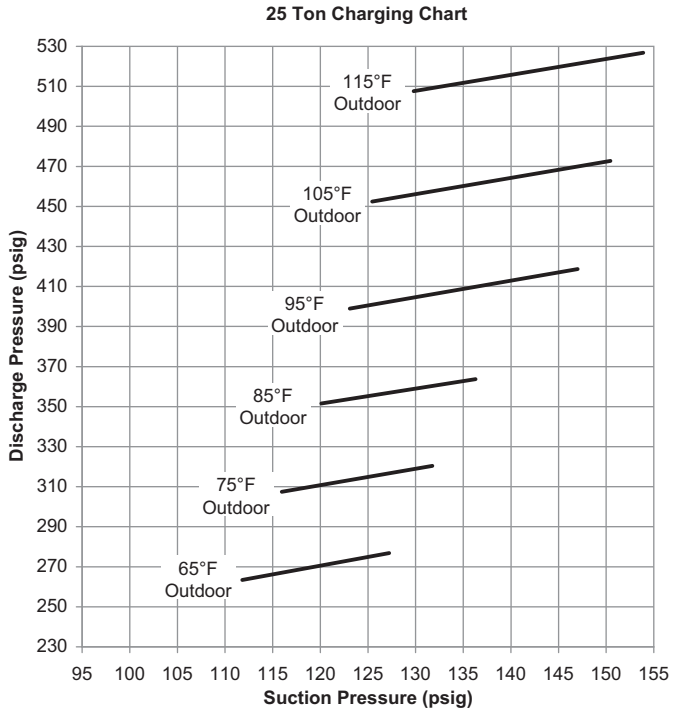

Figure 30: J25ZJ (25 Ton) Charging Chart

Troubleshooting

⚠WARNING

Troubleshooting of components may require opening the electrical control box with the power connected to the unit. **Use extreme care when working with live circuits!** Check the unit nameplate for the correct line voltage and set the voltmeter to the correct range before making any connections with line terminals.

For troubleshooting of optional VFD, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

When not necessary, shut off all electric power to the unit prior to any of the following maintenance procedures so as to prevent personal injury.

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation which could cause injury to person and/or damage unit components. Verify proper operation after servicing.

Cooling Troubleshooting Guide

On calls for cooling, if the compressors are operating but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in the “AUTO” position):

1. Turn the thermostat fan switch to the ON position. If the supply air blower motor does not energize, go to Step 2.
2. If the supply air blower motor does not energize when the fan switch is set to ON, check that line voltage is being supplied to the contacts of the M3, contactor, and that the contactor is pulled in. For units with VFD, check that line voltage is being supplied to the M3-Auxiliary contacts. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied to M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on internal protection. Cancel any thermostat calls and set the fan switch to AUTO. Wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts are present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.

   For units with VFD, if there is line voltage supplied at M3, M3 is pulled in, and the blower motor does not operate, check all power & control wiring connections to and from the drive and for any fault/warning messages displayed on the drive's digital display (refer to the drive user manual for full descriptions, if necessary). Clear any fault by pressing 'RESET' on the drive's keypad and take any corrective action as needed. If the motor still does not operate, replace the motor.
6. If 24 volts is not present at M3, check that 24 volts is present at the UCB supply air blower motor terminal, “FAN”. If 24 volts is present at the FAN, check for loose wiring between the UCB and M3.
7. If 24 volts is not present at the “FAN” terminal, check for 24 volts from the room thermostat. If 24 volts are not present from the room thermostat, check for the following:
   a. Proper operation of the room thermostat (contact between R and G with the fan switch in the ON position and in the AUTO position during operation calls).
   b. Proper wiring between the room thermostat and the UCB, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
9. If the thermostat and UCB are properly wired, replace the UCB.

On calls for cooling, the supply air blower motor is operating but compressor #1 is not (the room thermostat fan switch is in the “AUTO” position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling and the compressors will not immediately operate. If both stages of cooling are requested simultaneously and the economizer provides free cooling, following a short delay compressor #1 will be energized unless it is locked out. If compressor #1 is locked out, compressor #2 is energized. Compressor #2 is always energized in place of compressor #1 when compressor #1 is requested but locked out.
2. If no economizer is installed or the economizer is not opening to provide free cooling and compressor #1 does not energize on a call for cooling, check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts are present and M1 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.

7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts is not present from the room thermostat, check for the following:
   a. 24 volts at the thermostat Y1 terminal
   b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.
9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing an alarm code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, cancel any call for cooling. This will reset any compressor lock outs. If the LPS is still open after the ASCD, the compressor will not be energized for 30 seconds. The second and third times that the UCB sees an open LPS will count towards the three occurrences that will cause a UCB lock-out.

NOTE: While the above step will reset any lockouts, compressor #1 may be held off for the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.
11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 “OUT” terminal of the UCB. If 24 volts is present, trace the wiring from Y1 “OUT” for incorrect wiring. If 24 volts is not present at the Y1 “OUT” terminal, the UCB must be replaced.
12. *For units without economizers*: If 24 volts is present at the Y1 OUT terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 “ECON” terminal.
13. *For units with economizers*: If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 “ECON” terminal. If nothing is found, the economizer control may have faulted and is failing to return the 24-volt “call” to the Y1 “ECON” terminal even though the economizer is not providing free cooling. To test, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB’s Mate-N-Lock plug. If compressor #1 energizes, there is a fault in the economizer wiring or the economizer control.
14. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local distributors can test the UCB for this programming.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.
15. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.
16. If none of the above correct the error, replace the UCB.

On calls for the second stage of cooling, the supply air blower motor and compressor #1 are operating but compressor #2 is not (the room thermostat fan switch is in the “AUTO” position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling. If the second stage of cooling is requested, following a short delay, compressor #1 will be energized unless it is locked out. Typically, compressor #2 is energized only during free cooling if the call for the second stage of cooling persists for 20 minutes.
2. Compressor #2 will not energize simultaneously with compressor #1 if a call for both stages of cooling is received. The UCB delays compressor #2 by 30 seconds to prevent a power surge. If after the delay compressor #2 does not energize on a second stage call for cooling, check for line voltage at the compressor contactor, M2, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M2 is pulled in and voltage is supplied at M2, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M2 is not pulled in, check for 24 volts at the M2 coil. If 24 volts is present and M2 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M2, M2 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M2, check for 24 volts at the UCB terminal, C2. If 24 volts are present, check for loose wiring between C2 and the compressor contactor.
7. If 24 volts is not present at the C2 terminal, check for 24 volts from the room thermostat at the UCB Y2 terminal. If

24 volts is not present from the room thermostat, check for the following:

a. 24 volts at the thermostat Y2 terminal

b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and

c. Loose wiring from the room thermostat to the UCB

8. If 24 volts is present at the UCB Y2 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS2, LPS2, and FS2 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS2 has opened, there will be 24 volts of potential between the LPS2 terminals.

9. If 24 volts is present at the UCB Y2 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out,

   remove any call for cooling at the thermostat or by disconnecting the thermostat wiring at the Y1, Y2, Y3 and Y4 on the UCB terminal. This will reset any compressor lock outs, except LPS lockouts these can only be reset by cycling power to UCB.

NOTE: While the above step will reset any lock outs, compressor #1 will be held off for the ASCD, and compressor #2 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y2 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.

11. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local distributors can test the UCB for this programming.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.

12. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C2 terminal wire and jumper it to the Y2 terminal. DO NOT jump the Y2 to C2 terminals. If the compressor engages, the UCB has faulted.

13. If none of the above correct the error, replace the UCB.

On a call for cooling, the supply air blower motor and compressor #2 are operating but compressor #1 is not (the room thermostat fan switch is in the “AUTO” position):

1. Compressor #2 is energized in place of compressor #1 when compressor #1 is unavailable for cooling calls. Check the UCB for alarms indicating that compressor #1 is locked out. Press and release the ALARMS button if the LED is not flashing an alarm.

2. Check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.

3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.

4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts is present and M1 is not pulled in, replace the contactor.

5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.

6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.

7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts are not present at the UCB Y1 terminal, the UCB may have faulted. Check for 24 volts at the Y1 ECON terminal. If 24 volts is not present at Y1 “ECON”, the UCB has faulted. The UCB should de-energize all compressors on a loss of call for the first stage of cooling, i.e. a loss if 24 volts at the Y1 terminal.

8. If 24 volts are present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.

9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, remove any call for cooling. This will reset any compressor lock outs, except LPS lockouts. These can only be reset by cycling power to the UCB.

NOTE: While the above step will reset any lock outs, compressor #2 will be held off for the ASCD, and compressor #1 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.

11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 “OUT”

terminal of the UCB. If 24 volts is present, trace the wiring from Y1 “OUT” for incorrect wiring. If 24 volts is not present at the Y1 “OUT” terminal, the UCB must be replaced.

12. *For units without economizers:* If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 “ECON” terminal.

    For units with economizers: If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 “ECON” terminal. The economizer control may have faulted and is not returning the 24 volts to the Y1 “ECON” terminal even though the economizer is not providing free cooling. To test the economizer control, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB’s Mate-N-Lock plug.

13. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. They can be checked by local distributors.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.

14. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.

15. If none of the above correct the error, replace the UCB.

Gas Heat Troubleshooting Guide

On calls for heating, the draft motor operates and the furnace lights but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in “AUTO” position).

⚠WARNING

The furnace may shut down on a high temperature condition during the procedure. If this occurs, the UCB energize the supply air blower motor until the high temperature limit has reset. Caution should be used at all times as the supply air blower may energize regardless of the room thermostat fan switch position.

For troubleshooting of optional VFD, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

1. Place the thermostat fan switch in the “ON” position. If the supply air blower motor energizes, go to Step 9.
2. If the supply air blower motor does not energize when the fan switch is set to “ON,” check that line voltage is being supplied to the contacts of the M3 contactor, and that the contactor is pulled in. For units with VFD, check that line voltage is being supplied to the M3-Auxiliary contacts. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied at M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on inherent protection. Cancel any thermostat calls and set the fan switch to “AUTO”, wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts is present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.

    For units with VFD, if there is line voltage supplied at M3, M3 is pulled in, and the blower motor does not operate, check all power & control wiring connections to and from the drive and for any fault/warning messages displayed on the drive's digital display (refer to the drive user manual for full descriptions, if necessary). Clear any fault by pressing 'RESET' on the drive's keypad and take any corrective action as needed. If the motor still does not operate, replace the motor.

6. If 24 volts is not present at M3, check that 24 volts is present at the supply air blower motor terminal on the UCB. If 24 volts is present at the UCB terminal, check for loose wiring between the UCB and M3.
   a. If 24 volts is not present at the UCB supply air blower motor terminal, check for 24 volts from the room thermostat. If 24 volts is not present from the room thermostat, check for the following:
      - Proper operation of the room thermostat (contact between R and G with the fan switch in the “ON” position and in the “AUTO” position during operation calls.)
      - Proper wiring between the room thermostat and the UCB, and
      - Loose wiring from the room thermostat to the UCB
7. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
8. If the thermostat and UCB are properly wired, replace the UCB.
9. If the blower motor runs with the fan switch in the “ON” position but does not run shortly after the furnace has ignited when the fan switch is in the “AUTO” position, check the room thermostat for contact between R and G during “W1” calls.

On calls for heating, the supply air blower operates but the draft motor does not (the room thermostat fan switch is in the “AUTO” position).

1. The draft motor has inherent protection. If the motor shell is hot to the touch, wait for the internal overload to reset.
2. If the motor shell is cold with the room thermostat calling for heat, check for line voltage at the motor's Mate-N-Lok connector attached to the evaporator partition. If line voltage is present, replace the draft motor.
3. If line voltage is not present, check for line voltage at the heat relay (RW1) contacts in the main control box and check to see if the (RW1) is pulled in.
4. If the (RW1) relay is pulled in, check for a loose line voltage connection.
5. If the (RW1) relay is not pulled in, check for 24 volts at the (RW1) coil. If 24 volts is present, replace the (RW1) relay. If 24 volts is not present, check for a loose 24 volt connection back to the relay board and check the connections from the room thermostat to the relay board. If all connections are correct, replace the relay board.

The draft motor runs but the furnace does not light and the sparker does not spark.

1. The ignition control (IC1, IC2) may be locked out due to either a flame roll out or 100% shut off. These safety features are described above. If lock-out has occurred, 24V must be removed from the ignition controls. This is done at the unit or by resetting the room thermostat. After resetting 24V, check for proper furnace operation. If lock-out continues to occur, locate the source of the problem and correct.
2. Check all 24 volt connections from the relay board to and in the gas heat section. Check low voltage connections to the (ETD) located in the control box.
3. If the furnace is hot, it may be out on an over-temperature condition, wait for limit reset.
4. If the furnace is cold, check for 24 volts at wire 241 attached to the electrical time delay (ETD) located in the main control box. If 24 volts is not found, replace the ETD.
5. 24 volts is found at wire 241, remove the wires attached to the (TDR) and with a VOM, check for continuity across contacts 1 and 2. If none is found, the (TDR) is open and must be replaced. If there is continuity, re-attach the wires.With the draft motor running, check for 24 volts at terminal 4 of (RW1-2) and (RW2-1). If 24 volts is not present, the centrifugal switch (CS) has not closed or has gone bad. Check the line voltage to the unit - if it is correct, replace the draft motor. If line voltage is low, call the power company.
6. Check for 24V at terminal 2 of (RW1-2 and RW2-1). If 24V is not present, check for 24V at (RW1 and RW2) relay coils. If these relays are pulled in, then check for a loose connection at terminal 2 and terminal 4 of each relay. If no problem is found, then replace (RW1 and/or RW2) as required.
7. If 24 volts is present at the ignitor controls, check all control wiring at the ignitor controls and the high tension wire to the ignitors. Check that the ground wires from the ignitor controls, the gas valves and pilot burners are all intact and making good electrical connection. Check to make sure that the ceramic insulator on the pilot ignitors or sensors is not broken or cracked, if all are intact, replace the ignition control IC1 or IC2.

The draft motor runs and the ignitor sparks at the pilot burner but the pilot does not ignite and a gas odor is not detected at the draft motor outlet.

1. Check to make sure gas is being supplied to the unit. Make sure that the gas pressure to the unit is within the proper limits as described in the “POST START CHECK LIST” page 52 and that the pilot adjust screw is allowing some flow of gas as described in “PILOT CHECKOUT” page 54.
2. Check all wiring between the ignitor control and the gas valve. Check to make sure the ground connections are intact.
3. If the wiring is intact, check for 24 volts across terminals “PV” and “COMMON” on the ignitor control. If 24 volts is not present, replace the ignitor control.
4. If 24 volts is present, remove the pilot burner and remove the pilot orifice from the pilot burner. The orifice is removed in the direction opposite the flow of gas. Inspect the orifice for obstruction. If it is clear, replace the main gas valve.

The ignitor sparks at the pilot burner but the pilot does not ignite and a gas odor is detected at the draft motor outlet.

1. Adjust the pilot adjust screw on the gas valve as described in “PILOT CHECKOUT” page 54.
2. Check the supply pressure as described in “POST START CHECK LIST” page 52. Make adjustments as necessary.

3. Check the pilot orifice for obstruction as described in paragraph above. Clean as needed but the problem should not be the gas valve.

The pilot burner ignites but the ignitor continues to spark and the main burners do not ignite.

1. Make the same checks and adjustment as described in “PILOT CHECKOUT” page 54.
2. Check the supply pressure as described in “POST START CHECK LIST” page 52. Make adjustments as necessary.
3. Make sure that the pilot burner is not bent or damaged.
4. Make sure that the ground connections at the pilot burner, gas valve and ignitor control are intact. Check the high tension wire for good electrical connection. If all are intact, replace the ignitor module.

The pilot burner lights and the spark stops but the main burners do not light.

1. Check electrical connections between the ignitor control and the gas valve. If intact, check for 24 volts across terminals “MV” and “COMMON” terminals. If no voltage detected, replace ignitor control. If voltage is present, replace gas valve.

Furnace lights with roll-out or one burner has delayed ignition.

1. Make sure that the pilot burner is aligned properly with the carryover as described in “PILOT CHECKOUT” page 54.
2. Make sure that the carryovers on adjoining burners are screwed fast and are level with respect to one another.

Main burners light but exhibit erratic flame characteristics.

1. Adjust air shutters as described in “BURNER AIR SHUTTER ADJUSTMENT” page 54.
2. Check the main burner orifices for obstruction and alignment. Removal procedure is described in BURNER INSTRUCTIONS page 54. Clean or replace burner orifices and burners as needed.

Unit Control Board Flash Codes

Various flash codes are utilized by the unit control board (UCB) to aid in troubleshooting. Flash codes are distinguished by the short on and off cycle used (approximately 200ms on and 200ms off). To show normal operation, the control board flashes a 1 second on, 1 second off “heartbeat” during normal operation. This is to verify that the UCB is functioning correctly. Do not confuse this with an error flash code. To prevent confusion, a 1-flash, flash code is not used.

Alarm condition codes are flashed on the UCB lower left Red LED, See Figure 31. While the alarm code is being flashed, it will also be shown by the other LEDs: lit continuously while the alarm is being flashed. The total of the continuously lit LEDs equates to the number of flashes, and is shown in the table. Pressing and releasing the LAST ERROR button on the UCB can check the alarm history. The UCB will cycle through the last five (5) alarms, most recent to oldest, separating each alarm flash code by approximately 2 seconds. Flash code 21 is a non-alarm condition but due to the space constraints of the UCB, will be indicated by the Red LED. In all other cases, a flashing Green LED will be used to indicate non-alarm conditions.

In some cases, it may be necessary to “zero” the ASCD for the compressors in order to perform troubleshooting. To reset all ASCDs for one cycle, press and release the UCB TEST/ RESET button once.

Flash codes that do and do not represent alarms are listed in Table 25.

Table 25: Unit Control Board Flash Codes

Flash Codes	Description	Green LED 16	Red LED 8	Red LED 4	Red Led 2	Red LED 1
On Steady	This is a Control Failure	-	-	-	-	-
1 Flash	Not Applicable	-	-	-	-	-
2 Flashes	Control waiting ASCD[1]	Flashing	Off	Off	On	Off
3 Flashes	HPS1 Compressor Lockout	Off	Off	Off	On	On
4 Flashes	HPS2 Compressor Lockout	Off	Off	On	Off	Off
5 Flashes	LPS1 Compressor Lockout	Off	Off	On	Off	On
6 Flashes	LPS2 Compressor Lockout	Off	Off	On	On	Off
7 Flashes	FS1 Compressor Lockout	Off	Off	On	On	On
8 Flashes	FS2 Compressor Lockout	Off	On	Off	Off	Off
9 Flashes	Ignition Control Locked Out / Ignition Control Failure	Off	On	Off	Off	On
10 Flashes	Compressors Locked Out on Low Outdoor Air Temperature[1]	Flashing	On	Off	On	Off
11 Flashes	Compressors locked out because the Economizer is using free Cooling[1]	Flashing	On	Off	On	On
12 Flashes	Unit Locked Out due to Fan Overload Switch Failure	Off	On	On	Off	Off
13 Flashes	Compressor Held Off due to Low Voltage[1]	Flashing	On	On	Off	On
14 Flashes	EEPROM Storage Failure	Off	On	On	On	Off
15 Flashes	HPS3 Compressor Lockout	Off	On	On	On	On
16 Flashes	HPS4 Compressor Lockout	On	Off	Off	Off	Off
17 Flashes	LPS3 Compressor Lockout	On	Off	Off	Off	On
18 Flashes	LPS4 Compressor Lockout	On	Off	Off	On	Off
19 Flashes	FS3 Compressor Lockout	On	Off	Off	On	On
20 Flashes	FS4 Compressor Lockout	On	Off	On	Off	Off
21 Flashes	Compressor Off due to Low SAT[1]	On	Off	On	Off	On
OFF	No Power or Control Failure	Off	Off	Off	Off	Off

1. Non-alarm conditions.

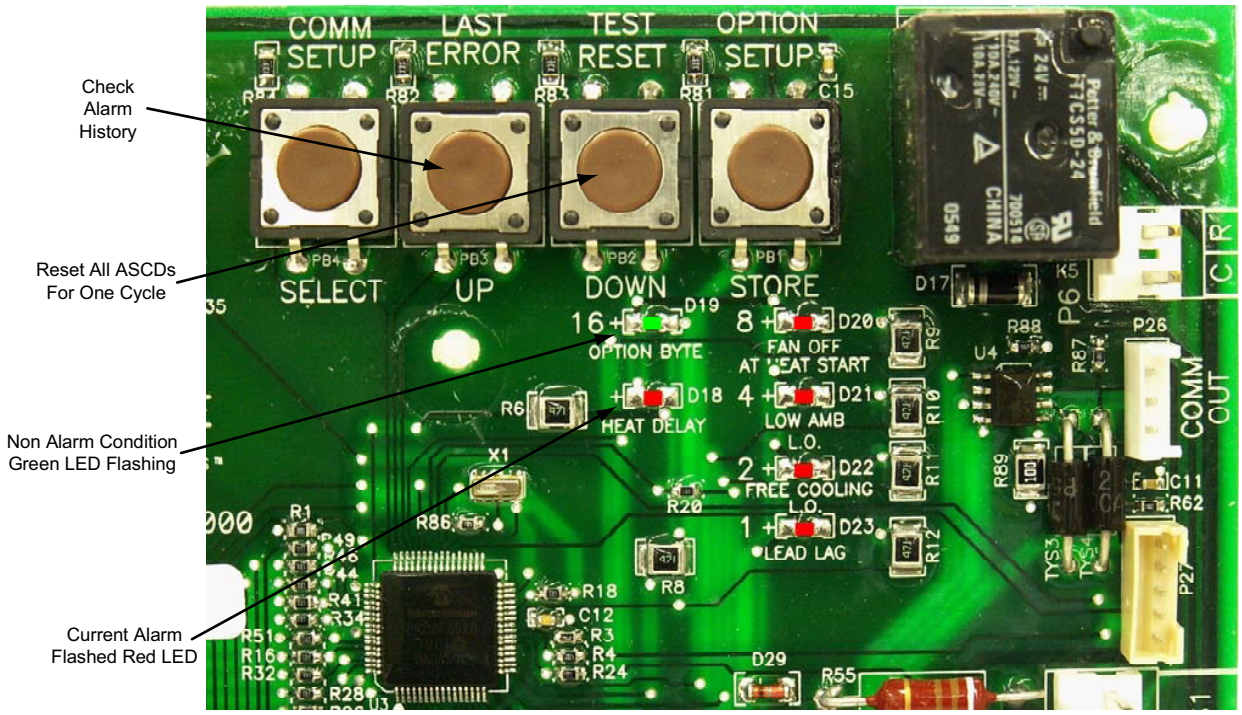

Figure 31: Unit Control Board

Unit Control Board Option Setup

Option Byte Setup

- Enter the Option Setup mode by pushing the OPTION SETUP / STORE button, and holding it for at least 2 seconds.
- The green status LED (Option Byte) will be turned on and the red status LED (Heat Delay) is turned off.
- The 8, 4, 2 and 1 LEDs will then show the status of the 4 labeled options (**(8) Fan Off at Heat Start**, **(4) Low Ambient Lockout**, **(2) Free Cooling Lockout**, and **(1) Lead / Lag)**.
- Press the UP or Down button to change the LED status to correspond to the desired Option Setup.
- To save the current displayed value, push the OPTION SETUP / STORE button and hold it for at least 2 seconds. When the value is saved, the green LED will flash a few times and then normal display will resume.

NOTE: While in either Setup mode, if no buttons are pushed for 60 seconds, the display will revert to its normal display, exiting the Option Setup mode. **When saving, the control board only saves the parameters for the currently displayed mode (Option Byte or Heat Delay).**

Heat Delay Setup

- Enter the Option Setup mode by pushing the OPTION SETUP / STORE button, and holding it for at least 2 seconds.
- The green status LED (Option Byte) will be turned on and the red status LED (Heat Delay) is turned off.
- Press the COMM SETUP / SELECT button to toggle into the Heat Delay Setup, the green LED will turn off and the red LED for Heat Delay will turn on.
- The 8, 4, 2 and 1 LEDs will then show the status of the Heat Delay, (See Table 26). Press the UP or Down button to change the LED status to correspond to the desired Heat Delay Value.
- To save the current displayed value, push the OPTION SETUP / STORE button and hold it for at least 2 seconds. When the value is saved, the red LED will flash a few times and then normal display will resume.

NOTE: While in either Setup mode, if no buttons are pushed for 60 seconds, the display will revert to its normal display, exiting the Option Setup mode. **When saving, the control board only saves the parameters for the currently displayed mode (Option Byte or Heat Delay).**

Table 26: Heat Delay

Heat Fan On Delay	Heat Fan Off Delay	Red LED 8	Red LED 4	Red LED 2	Red LED 1
60	180	On	On	On	On
60	90	On	On	On	Off
60	60	On	On	Off	On
60	30	On	On	Off	Off
45	180	On	Off	On	On
45	90	On	Off	On	Off
45	60	On	Off	Off	On
45	30	On	Off	Off	Off
30	180	Off	On	On	On
30	90	Off	On	On	Off
30	60	Off	On	Off	On
30	30	Off	On	Off	Off
0	60	Off	Off	On	On
0	30	Off	Off	On	Off
0	10	Off	Off	Off	On
Non-std	Non-std	Off	Off	Off	Off

Optional VAV Control Board Flash Codes

Flash codes are also utilized by the VAV add-on board to aid in troubleshooting optional VAV applications. Flash codes are displayed by a red LED located near the center of the board using a short on/off cycle (approximately 200-ms on and 200-ms off).

To verify that the board is functioning correctly, the LED will display a repetitive 1 second on, 1 second off "heartbeat". Do not confuse this "heartbeat" with the error flash codes shown in the table below. To prevent confusion, a 1-flash, flash code is not used.

Table 27: VAV Control Board Flash Codes

FLASH CODE	DESCRIPTION
On Steady	Control Failure
1 Flash	Not Applicable
2 Flashes	Loss of Communication with UCB
3 Flashes	Space Sensor Failure
4 Flashes	SAT Sensor Failure
5 Flashes	RAT Sensor Failure
6 Flashes	OAT Sensor Failure
7 Flashes	OH Sensor Failure
8 Flashes	RH Sensor Failure
9 Flashes	IAQ Sensor Failure
10 Flashes	OAQ Sensor Failure
11 Flashes	APS Sensor Failure
12 Flashes	Limit 2 Switch Open
13 Flashes	Purge
14 Flashes	VFD Input Failure
15 Flashes	Dirty Filter Switch
OFF	No Power or Control Failure

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860261-JIM-B-0612
Supersedes: 860261-JIM-A-0612

Johnson Controls Unitary Products
5005 York Drive
Norman, OK 73069

O&M COVER SHEET

SECTION: 2
PRODUCT: EXHAUST FANS

Paulson-Cheek Mechanical, Inc.
6145 Norhtbelt Parkway, Suite F
Norcross, GA 30071

PHONE: 770-729-0076
FAX: 770-729-1076

PROJECT: **Pinewood Atlanta - Building 3**

LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

DATE RECEIVED:	06/05/14
MANUFACTURER:	PENN BARRY
SUPPLIER:	GAA
SUBMITTED DATE:	06/05/14

[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

THIS APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE SUBCONTRACTOR OR VENDOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

CHECKED BY:	WILLIAM HAGLER
DATE CHECKED:	06/05/14

Please read and save these instructions. *Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*

PENN BARRY

Dynamo Fans

Receiving and Handling

PennBarry fans are carefully inspected before leaving the factory. When the unit is received, inspect the carton for any signs of tampering. Inspect the unit for any damage that may have occurred during transit and check for loose, missing or damaged parts. Mishandled units can void the warranty provisions. If units are damaged in transit, it is the responsibility of the receiver to make all claims against the carrier. PennBarry is not responsible for damages incurred during shipment.

Avoid severe jarring and/or dropping. Handle units with care to prevent damage to components or finishes. If the unit is scratched due to mishandling, the protective coating may be damaged. Incorrect lifting may damage the fan and void the warranty.

Storage

Long-term storage requires special attention. Store units on a level, solid surface, preferably indoors. If outside storage is necessary, protect the units against moisture and dirt by encasing the cartons in plastic or in some similar weatherproof material. Periodically inspect units and rotate wheels to spread bearing lubricant. Failure to rotate wheels results in reduced bearing life and may void the manufacturer's warranty. If the unit will be stored for an extended time, remove belts. Belts which remain under tension in a stationary position for extended periods are likely to have a reduced operating life.

Unpacking

Place the carton in an upright position and remove the staples or use a sharp (knife edge) tool to carefully cut or scribe the sealing tape on both sides at the top of the carton. Open carton flaps. Remove any cardboard and wooden filler pieces, as well as loose components or accessories shipped with the unit.

Carefully remove the unit from the carton. Inspect the unit for any damage that may have occurred during transit and check for loose, missing or damaged parts.

Installation

For all units, determine the minimum safe floor or roof loading requirement for proper support, minimally by multiplying the total weight of the unit by two. Follow local codes and good practices to ensure proper anchoring of roof top units. A minimum of 12" clearance should be provided for adequate heat dissipation. For Dynamos, flex pads, etc. are available to reduce the transmission of vibration to the surrounding areas. See suggested ductwork installations. See dimensional information following. **Blowers suitable for Restaurant Exhaust Appliances (YZHW) are accordingly labeled. These units require installation according to NFPA96 Standards, local codes and general practices.** For curb mounting, to assure a positive seal, apply a high temperature gasket material on the roof curb.

INSTALLING DAMPERS

When required, install dampers prior to mounting the unit on the curb or frame. Secure dampers to the inside of the curb without undue twisting, which may distort the damper frame. Damper frame must be reasonably level on all sides. Check for free operation. If dampers are motor operated type, ascertain that proper voltage is impressed on motor terminals.

POSITIONING AND RUNNING POWER LINES

Power is normally brought from within the building and placed inside one corner of the curb. Feed power line through the clearance hole provided in the damper and in turn through the electrical conduit hole provided in the base of the exhauster (fed through rubber grommets on smaller units). If local codes require special electrical wire of unusually large size, then remove and discard the electrical conduit (or grommets).

INSTALLING THE FAN

For access to motor and drive assembly, simply remove or lift access hood and make necessary power connections to motor (through disconnect switch if required). Provide a generous amount of slack in power line between motor and disconnect switch to allow for motor deflections, and to permit movement or motor for belt tension adjustments.

ANCHORING OR SECURING THE UNIT

Whenever possible, anchor the fan by fastening through the vertical portion of the mounting flange. The type of fastener depends upon curb construction and using two fasteners per side constitutes adequate anchoring under normal conditions. If code or specification prescribes fastening through the top (horizontal portion) of the mounting flange, use neoprene or lead washers under the head of each fastener to prevent water leaks.

⚠ CAUTION ***Guy down large units installed in areas subject to high winds or unusual field conditions.***

To complete the re-assembly of the unit secure hood to frame by replacing all spacers, washers and nuts exactly as they were found prior to removal. The unit is now ready for service. Apply power and check rotation as indicated by arrow in motor compartment. The rotation of all centrifugal ventilators is counterclockwise when viewing the unit from above the motor compartment.

1401 North Plano Road, Richardson, Texas 75081
Phone: 972-234-3202 ▪ Fax: 972-497-0468

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PART #59652-0

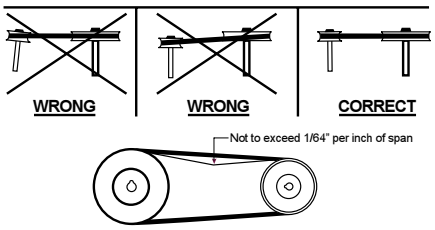
Start-Up and Operation

Carefully inspect the unit before start-up. All motor bearings should be properly lubricated and all fasteners should be securely tightened. Rotate blower wheels by hand to insure free movement. Make sure the inlets and approaches to the exhauster are clean and free from obstruction. To assure maximum air movement, adequate supply air must be available.

Rough shipping or handling may cause the wheel or propeller to move away from the venturi inlet. That condition can cause the fan to move less air. If that occurs, loosen set screws and adjust the impeller closer to the inlet. Retighten all hardware securely.

Check condition of belts and the amount of tension prior to start-up. When it becomes necessary to adjust belt tension, do not overtighten as bearing damage will occur. Recommended belt tension should permit deflection of 1/64" per inch of span of the belt on each side of the belt measured halfway between the pulley centerline. Exercise extreme care when adjusting belts as not to misalign the pulleys. Any misalignment will cause a sharp reduction in belt life and produce squeaky, annoying noises (See figure 1). On units equipped with two or three groove pulleys, adjust all belts with equal tension.

Figure 1: Pulley Alignment & Tension



⚠ CAUTION ***Whenever belts are removed or installed, never force belts over pulleys without loosening motor first to relieve belt tension.***

Before applying power to the motor, check the following:

a. Check line voltage with motor nameplate.

b. On single phase motors, set-up the terminal blocks in accordance with the nameplate instructions (or wiring diagram). The set up must match the line voltage.

c. If the motor is three phase, group and connect the winding leads as shown on the wiring diagram. The line voltage must correspond with proper grouping of motor leads.

d. On two speed motors, follow the wiring diagram explicitly or serious motor damage will occur.

e. Activate the blower and allow it to operate.

f. Carefully check the rotation of the wheel to insure operation in the proper direction.

⚠ CAUTION ***Incorrect rotation overloads motor severely and results in serious motor damage. To change rotation of three phase units simply interchange any two of the three line leads. On single phase units change the terminal block set-up following the wiring diagram.***

g. Check that bearing temperatures are not excessively hot.

h. Check that all bolts and hangers are secure after one (1) hour of continuous operation.

NOTE: Take care to follow all local electrical, safety and building codes. Follow provisions of the National Electrical Code as well as the Occupational Safety and Health Act.

⚠ CAUTION ***Always disconnect power source before working on the unit.***

GUARD AND PROTECT ALL MOVING PARTS

All motors are checked prior to shipment. However, if motor defects should develop, prompt service can be obtained from the nearest authorized service station of the motor manufacturer under the warranty. Exchange, repair or replacement will be provided on a no charge basis if the motor is defective within the warranty period. Do not return defective motors to PennBarry. Motor guarantee is void unless overload protection is provided in motor wiring circuit.

Maintenance

Do not attempt maintenance on fan until the electrical supply has been completely disconnected. If a disconnect switch has not been provided, remove all fuses from the circuit and lock the fuse panel so they cannot be accidentally replaced.

Lubrication is a primary maintenance responsibility. Check all bearings periodically. Inspect belts for tightness. If the fan is installed in a corrosive or dirty atmosphere, periodically clean the centrifugal wheel, inlet, motor housing and other moving parts.

FAN SHAFT LUBRICATION

Fan shaft bearing pillow blocks are furnished in either the prelubricated sealed-for-life type or the greasable type depending on what was ordered. The prelubricated type requires no servicing for 7 to 10 years of normal use and the greasable type are factory greased eliminating the need for greasing initially. Follow the lubricating schedule recommended by the factory. This practice should not supersede any safety considerations.

⚠ CAUTION ***Use low pressure grease guns only. High pressure guns tend to blow out or unseat bearing seals, leaving the bearing open to collect grime, dust and foreign particles.***

LUBRICATION SCHEDULE

Always follow the bearing manufacturer's recommended lubrication schedule. If none is available us the following general schedule.

a. Under average conditions where ambient temperatures do not exceed 120°F., lubrication is required 1 to 2 times a year.

b. Under dirt laden atmosphere where there is a temperature range of 120°F to 150°F, lubrication is required from 3 to 6 times a year.

c. Under extreme temperature conditions and extremely dirty atmospheres, lubrication should be scheduled at least once or twice a month.

d. Belt drive units maximum temperature should not exceed 160°F. Direct driven models have temperature range stamped on motor.

MOTOR LUBRICATION

In general, standard motors are furnished with prelubricated, sealed-for-life ball bearings which require no lubrication for 7 to 10 years of normal service. Where motors have been ordered with greasable bearings, these bearings are factory lubricated and require no attention for one year under normal conditions. If grease relief fittings are provided, remove them when performing maintenance to allow grease to flow out. Whenever possible, apply grease while the motor is running. This practice should not supersede any safety considerations. DO NOT OVER-GREASE, as most lubricants deteriorate motor windings, thereby reducing motor life.

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Table 1: Recommended Lubricants

Manufacturer	Product	Temp. Range
BP	LG-#P-1	Below 32°F (0°C)
Gulf	Gulfcrown EP-1	
Imperial Oil	Unirex EP-1	
Shell	Alvania R-1	
BP	Energrease, MPMK11	32°F to 150°F (0°C to 66°C)
Gulf	Gulfcrown EP-2	
Imperial Oil	Unirex EP-2	
Shell	Alvania R-3	
Sun Oil	Sun Prestige 42	
Texaco	Regal AFB2	

Replacement Parts

Replace parts with components which duplicate original parts correctly. Incorrectly sized shafts, belts, pulleys, etc. can damage the fan.

Spare or replacement parts and prices are available upon request. Please supply the following information: Factory Order Number, Customer's Name and Order Number and Date. If this information is not available, furnish a complete description of the part required. Names of parts are shown on the following drawing. To order motors provide the HP, RPM, voltage, phase, hertz and type of enclosure.

Figure 2: Dynamo Centrifugal Blower Class 1, S.W.S.I.

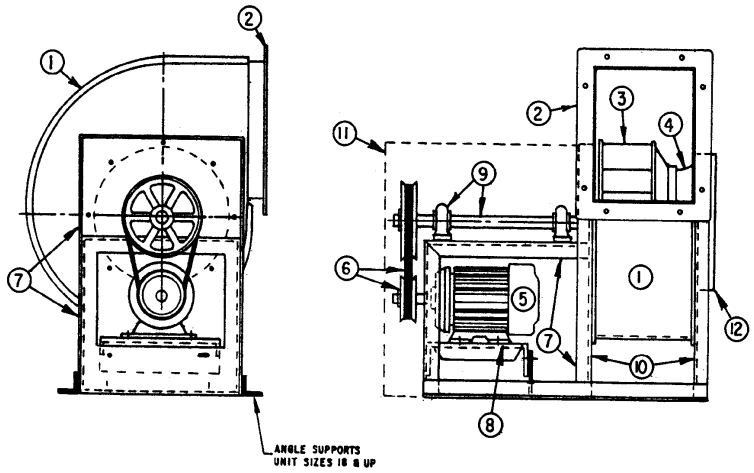


Figure 3: Blower Accessories

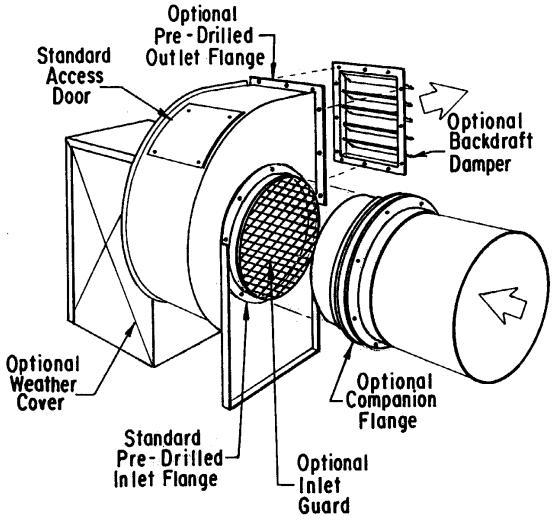


Figure 4: Correct Inlet & Outlet Duct Arrangements

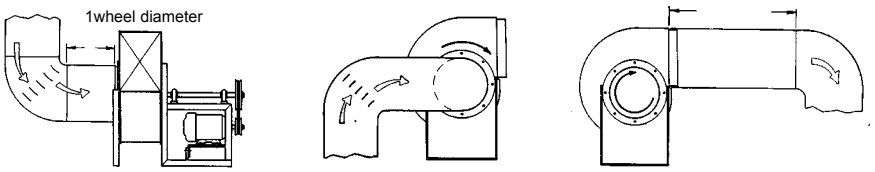
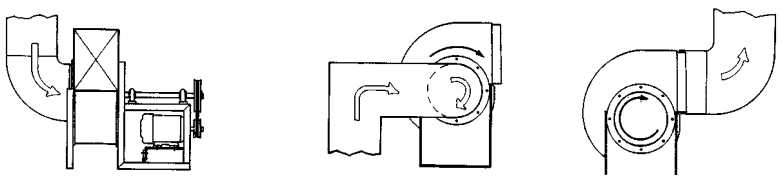


Figure 5: Incorrect Inlet & Outlet Duct Arrangements



PARTS LISTS

1. Blower Scroll Housing
2. Outlet Duct Flange (optional)
3. Centrifugal Wheel (aluminum non-overloading)
4. Spun Inlet
5. Ball Bearing Motor
6. Belt and Pulleys
7. Drive Frame Support Assembly
8. Adjustable Motor Mouthing Plate
9. Fan Shaft and Bearings
10. Support Legs with Mounting Holes
11. Belt and Bearing Enclosure (optional)
12. Round Inlet Ring

Dynapak Typical Installation

Figure 6

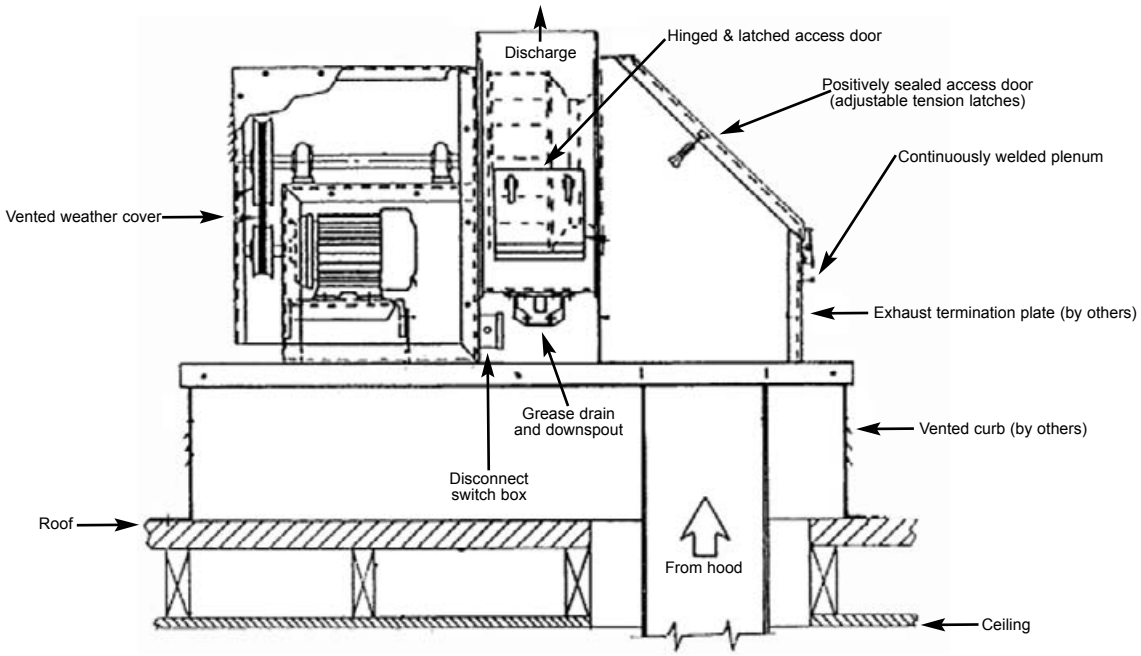


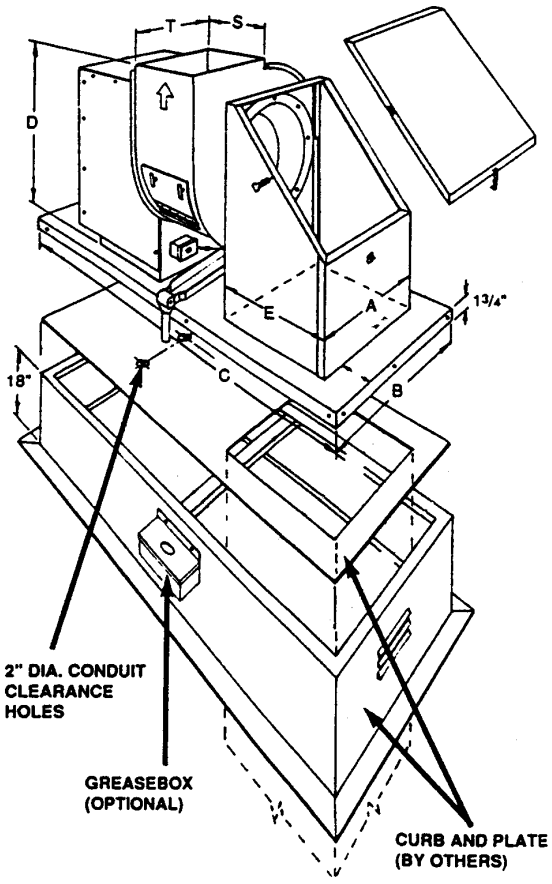
Table 2: Dimensions

Model	A	B	C	D	E	F	G
D10DP	3/4	14 1/4	26 1/8	52 1/8	24 1/8	17 9/16	5 1/32
D13DP	1	17 7/16	28 1/8	56 1/8	28 5/16	17 5/16	4 31/32
D16DP	1 3/16	20 15/16	34 1/8	68 1/8	34 5/16	20 13/16	6 1/32
D20DP	1 3/16	24 1/2	40 3/16	80 3/16	40 5/16	24 5/16	6 1/32
D24DP	1 7/16	29 5/16	44 3/16	88 3/16	48 3/4	29 1/16	5 31/32

Table 3: Dimensions

Model	S	T
D10DP	8 1/4	11 1/4
D13DP	10 1/2	14 3/8
D16DP	12 3/4	17 1/2
D20DP	14 3/4	21 3/4
D24DP	19	26

Figure 7



1401 North Plano Road, Richardson, Texas 75081
Phone: 972-234-3202 ▪ Fax: 972-497-0468

Troubleshooting Checklist

Symptom	Possible Cause(s)	Corrective Action
Excessive noise	1. Defective or loose motor bearings	1. Replace motor with same frame size, RPM, HP
	2. Ventilator base not securely anchored	2. Reset properly
	3. Loose or unbalanced wheel/propeller	3. Tighten screws, remove build-up, balance wheel/propeller
	4. Misaligned pulleys or shaft	4. correct alignment
	5. Loose or damaged wheel/propeller	4. Replace wheel/propeller
	6. Wheel running in wrong direction	6. Reverse direction
Fan inoperative	1. Blown fuse or open circuit breaker	1. Replace fuses or circuit breaker
	2. Loose or disconnected wiring	2. Shut off power and check wiring for proper connections
	3. Defective motor	3. Repair or replace motor
	4. Broken belts	4. Replace belts
Insufficient airflow	1. Open access doors or loose sections of ducts	1. Check for leakage
	2. Clogged filters	2. Clean filters
	3. Operation in wrong direction	3. Correct rotation of wheel/propeller
	4. Insufficient make-up air direction	4. Add make-up fan or louver opening
Water leaking into ductwork or collection of grease under fan	1. Fan installed with slope in the wrong direction	1. Slope should be fitted in the direction of the drainage opening or grease collection box and drain spout
	2. Clogged drain spout	2. Clean drain spout
	3. Cooling tube or motor dome top removed	3. Install new cooling tube with gasket and dome top
	4. Grease container full	4. Empty grease box
Motor overheating	1. Belt slippage	1. Adjust tension or replace bad belts
	2. Overvoltage or under voltage	2. Contact power supply company
	3. Operation in wrong direction	3. Reverse direction of motor
	4. Fan speed too high	4. Slow down fan by opening variable pitch pulley on motor shaft
	5. Incorrect motor (service factor 1.0, low ambient temperature)	5. Replace motor with correct open, NEMA service factors (1.15 or higher) with 40 degrees ambient
	6. Blocked cooling tube or leaky gasket	6. Remove blockage and seal cooling tube in place
	7. Insufficient airflow to kitchen hood fan operating on low speed with kitchen in full operation	7. Check airflow under hood and adjust kitchen equipment output
	8. Undersized motor	8. Check motor ratings with catalog speed and air capacity chart

Note: Care should be taken to follow all local electrical, safety and building codes. Provisions of the National Electric Code (NEC), as wells as the Occupational Safety and Health Act (OSHA) should be followed.

All motors are checked prior to shipment. If motor defects should develop, prompt service can be obtained from the nearest authorized service station of the motor manufacturer while under warranty. Exchange, repair or replacement will be provided on a no charge basis if the motor is defective within the warranty period. The PennBarry representative in your area will provide a name and address of an authorized service station if requested. WARNING: Motor guarantee is void unless overload protection is provided in motor wiring circuit.

Limited One Year Warranty

What Products Are Covered
PennBarry Fans and Ventilators (each, a "PennBarry Product")

One Year Limited Warranty For PennBarry Products
PennBarry warrants to the original commercial purchaser that the PennBarry Products will be free from defects in material and workmanship for a period of one (1) year from the date of shipment.

Exclusive Remedy
PennBarry will, at its option, repair or replace (without removal or installation) the affected components of any defective PennBarry Product; repair or replace (without removal or installation) the entire defective PennBarry Product; or refund the invoice price of the PennBarry Product. In all cases, a reasonable time period must be allowed for warranty repairs to be completed.

What You Must Do
In order to make a claim under these warranties:

1. You must be the original commercial purchaser of the PennBarry Product.
2. You must promptly notify us, within the warranty period, of any defect and provide us with any substantiation that we may reasonably request.
3. The PennBarry Product must have been installed and maintained in accordance with good industry practice and any specific PennBarry recommendations.

Exclusions
These warranties do not cover defects caused by:

1. Improper design or operation of the system into which the PennBarry Product is incorporated.
2. Improper installation.
3. Accident, abuse or misuse.
4. Unreasonable use (including any use for non-commercial purposes, failure to provide reasonable and necessary maintenance as specified by PennBarry, misapplication and operation in excess of stated performance characteristics).
5. Components not manufactured by PennBarry.

Limitations
1. In all cases, PennBarry reserves the right to fully satisfy its obligations under the Limited Warranties by refunding the invoice price of the defective PennBarry Product (or, if the PennBarry Product has been discontinued, of the most nearly comparable current product).
2. PennBarry reserves the right to furnish a substitute or replacement component or product in the event a PennBarry Product or any component of the product is discontinued or otherwise unavailable.
3. PennBarry's only obligation with respect to components not manufactured by PennBarry shall be to pass through the warranty made by the manufacturer of the defective component.

General
The foregoing warranties are exclusive and in lieu of all other warranties except that of title, whether written, oral or implied, in fact or in law (including any warranty of merchantability or fitness for a particular purpose).

PennBarry hereby disclaims any liability for special, punitive, indirect, incidental or consequential damages, including without limitation lost profits or revenues, loss of use of equipment, cost of capital, cost of substitute products, facilities or services, downtime, shutdown or slowdown costs.

The remedies of the original commercial purchaser set forth herein are exclusive and the liability of PennBarry with respect to the PennBarry Products, whether in contract, tort, warranty, strict liability or other legal theory shall not exceed the invoice price charged by PennBarry to its customer for the affected PennBarry Product at the time the claim is made.

Inquiries regarding these warranties should be sent to: PennBarry, 1401 North Plano Road, Richardson, TX 75081.

1401 North Plano Road, Richardson, Texas 75081
Phone: 972-234-3202 ▪ Fax: 972-497-0468

O&M COVER SHEET

SECTION: 3
PRODUCT: ELECTRIC HEATERS

Paulson-Cheek Mechanical, Inc.
6145 Norhtbelt Parkway, Suite F
Norcross, GA 30071

PHONE: 770-729-0076
FAX: 770-729-1076

PROJECT: **Pinewood Atlanta - Building 3**

LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

DATE RECEIVED:	06/05/14
MANUFACTURER:	RAYWALL
SUPPLIER:	GAA
SUBMITTED DATE:	06/05/14

[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

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CHECKED BY:	WILLIAM HAGLER
DATE CHECKED:	06/05/14

FPQ

3310 SERIES

INSTALLATION INSTRUCTIONS

TPI Corporation
P.O. Box 4973
Johnson City, TN
37602-4973
America's Comfort Conditioning Company

1. LOCATION OF HEATER:

A. Heater is mounted on the wall near ceiling or floor, air flow down. **CAUTION:** Do not obstruct the front grille of the heater with curtains, furniture, etc., since the proper operation of the heater requires a free flow intake and exhaust of air.
B. Minimum mounting height is 8" above finished floor.
C. For surface mounting use adapter FQP/3310EX33.

2. BEFORE MOUNTING:

A. Insure that the supply voltage matches voltage rating on the label of the heater.
B. Turn off electrical power to heater circuit.

3. MOUNTING INSTRUCTIONS:

A. Disassemble heater by removing 7 screws "C" as shown in Figure 1 and 2.
B. Flush mounting, see Fig. 1.
Place rough-in box "A" between studs at desired height: secure to studs through holes "M". The flanges on the rough-in box must rest on the surface of the finished wall; if the box is installed prior to the application of the finished wall, allowance must be made for the wall thickness.
C. Surface mounting, See Fig. 2.
Insert rough-in box "A" into surface adapter "E". Secure the heater rough-in box to wall at desired height through holes "X". Be sure that the rough in box is centered in surface adapter. For surface mounting, bring wiring through bottom knockout "K" only.
D. Place assembly "B" into rough-in box "A". Secure with six screws "C".

4. WIRING INSTRUCTIONS REF: Diagrams WD1, WD2, WD3, WD4.

A. Field Conversion for Lower Wattage: All units are factory wired for higher wattage rating. (See paragraph 9 for conversion to lower wattage rating).
B. Bring service leads through knockout "K" on top or bottom of rough-in box for flush or semi-recessed mounting, bottom knockout "K" only for surface mounting. When wiring from the bottom, install wire through cover "G" by removing screw "H".
C. Attach service leads to two black leads on 208-240 volt models and to black and white leads on 120-277 volt models, attach ground lead to green wire with approved connectors. Comply with all national and local codes.
D. Attach wiring compartment cover "D" to assembly with screw "C".

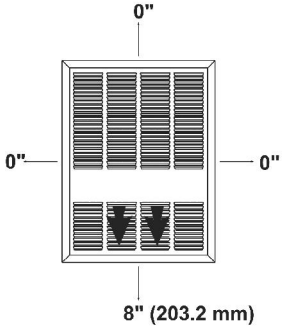
5. FINAL STEPS:

A. Clean all construction dirt and debris from inside heater.
B. Attach front grille "F" with four screws "L". A parts bag containing the cover screws and the thermostat knob is located inside of heater.
C. Attach thermostat knob "T".

6. OPERATING INSTRUCTIONS:

A. Turn on power at the circuit breaker panel.
B. If there are two controls on the front grille of the heater; the one on your left "T" is the thermostat control and should be set to the position to give the desired comfort heat in the room. The switch on your right is the mode selection switch. Two modes of heating operation are available: CONSTANT: Fan runs continuously while thermostat cycles heating elements on and off as required by setting; and AUTO: Fan and heating elements cycle on and off simultaneously on thermostat control. The fan can be operated separately to circulate room temperature air by turning thermostat to its lowest setting and placing fan selector switch in the "CONSTANT" position.
C. After the desired temperature is reached, turn thermostat stem counter clockwise until a click is heard from the thermostat.
D. Models with double pole thermostats: Turn thermostat adjustment knob fully counter-clockwise to the "OFF" position . This will de-energize the heating element and fan.

Wall Installation



7. CLEANING AND MAINTENANCE INSTRUCTIONS:

A. At the beginning of each heating season, disconnect electrical power at circuit breaker panel. Remove front grille.
B. Use the narrow (crevice" suction attachment of the vacuum cleaner to remove dust and lint from heater and heating element.
C. Lubricate the motor with SAE No. 10 oil. Two (2) oil spouts are located on front and back of motor.
D. Reinstall front grille with previously removed screws. Restore power to the heater.

FIG. 1 FLUSH MOUNT

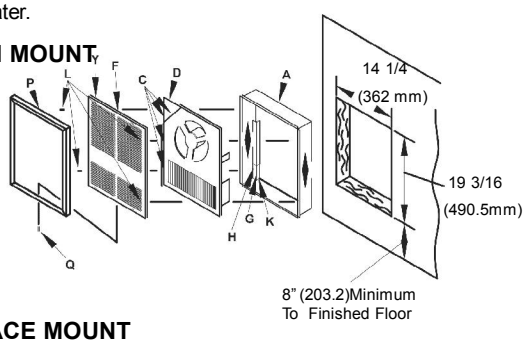
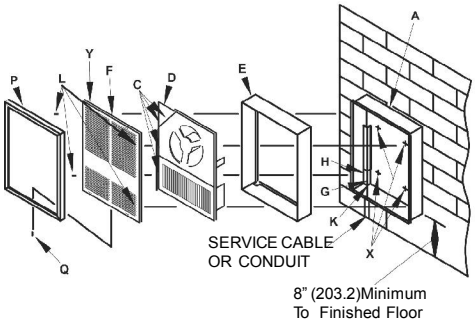


FIG. 2 SURFACE MOUNT



Note: This heater employs a visual alarm (light) to warn that parts of the heater are getting excessively hot. If the alarm illuminates, immediately disconnect power from heater and inspect for any objects on or adjacent to the heater that may cause high temperatures. DO NOT OPERATE HEATER WITH THE ALARM (LIGHT) ILLUMINATED.

Form 9821
ECO 1-5340

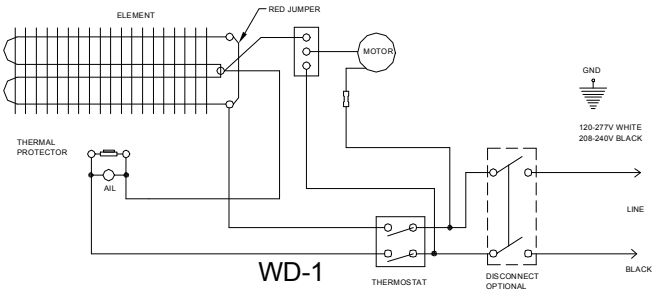
IMPORTANT: OWNER SHOULD RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE

TROUBLE SHOOTING		
Symptom	Possible Fault(s)	Remedy
Heater Does Not Operate	1. Electrical Circuit Open	1. A. Close electric circuit. B. Verify correct supply voltage. C. Adjust thermostat to higher setting.
	2. Defective Thermostat	2. Check continuity with an ohm meter. Replace defective part if necessary.
	3. Thermal Cut Out Open (Alarm Light On)	3. A. Remove any obstruction from front of heater B. Verify correct supply voltage.
Heat On But Fan Does Not Operate	1. Fan Motor Failure	1. A. Verify correct supply voltage. B. Check motor wiring connections. C. Replace defective motor if necessary.

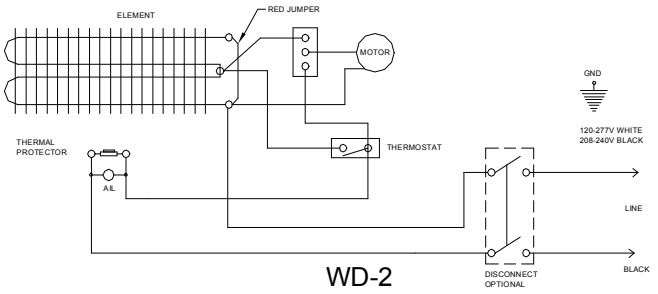
9. Field Conversion For Lower Wattage: To convert heater to a lower wattage rating. Remove (Red Jumper) from heating element (See WD1, WD2, WD3 and WD4). The wattage will be reduced to half of the nameplate wattage. (See Figure 3 for model numbers rated dual wattage).

FIGURE 3

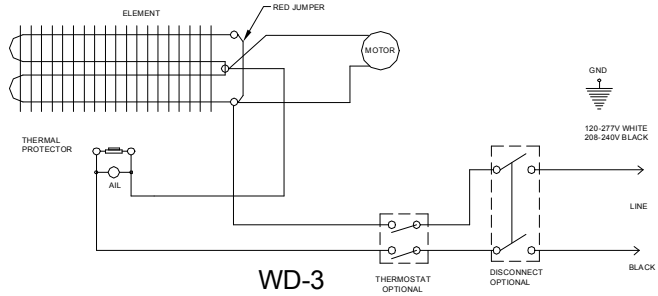
MODEL NO.	VOLTAGE	WATTAGE	AMPERAGE
E3313RP	120	1500	12.5
	120	750	6.25
HF3315RP	240/208	3000/2250	12.5/10.8
	240/208	1500/1125	6.2/5.4
HF3316RP	240/208	4000/3000	16.7/14.4
	240/208	2000/1500	8.3/7.2



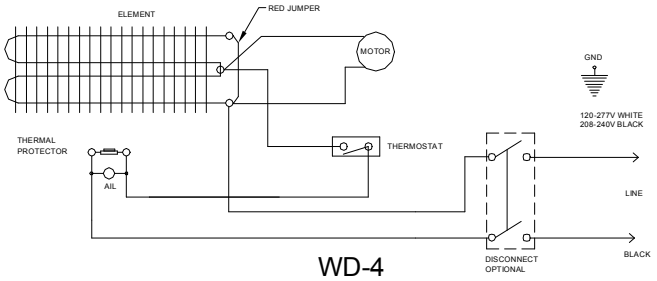
WD-1



WD-2



WD-3



WD-4

WD-1 3310 with Summer Fan Switch, Double Pole T-Stat and (Optional Disconnect Switch)
WD-2 3310 with Summer Fan Switch, Single Pole T-Stat and (Optional Disconnect Switch)
WD-3 3310 with (Optional Double Pole T-Stat and Disconnect Switch)
WD-4 3310 with Single Pole T-Stat and (Optional Disconnect Switch)

AIL Alarm Indicator Lights

Form 9821
ECO 1-5340

IMPORTANT: OWNER SHOULD RETAIN THESE INSTRUCTIONS FOR FUTURE REFERENCE

O&M COVER SHEET

SECTION: 4
PRODUCT: VARIABLE FREQUENCY DRIVES

Paulson-Cheek Mechanical, Inc.
6145 Norhtbelt Parkway, Suite F
Norcross, GA 30071

PHONE: 770-729-0076
FAX: 770-729-1076

PROJECT: **Pinewood Atlanta - Building 3**

LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

DATE RECEIVED:	06/05/14
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CHECKED BY:	WILLIAM HAGLER
DATE CHECKED:	06/05/14

DURA PULSE

AC Drive
User Manual

230V Class:
1 - 50 Hp

460V Class:
1 - 100 Hp

AUTOMATIONDIRECT.com

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At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

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WARNING

WARNING: Read this manual thoroughly before using *DURAPULSE* Series AC Motor Drives.

WARNING: AC input power must be disconnected before performing any maintenance. Do not connect or disconnect wires or connectors while power is applied to the circuit. Maintenance must be performed only by a qualified technician.

WARNING: There are highly sensitive MOS components on the printed circuit boards, and these components are especially sensitive to static electricity. To avoid damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.

WARNING: A charge may still remain in the DC-link capacitor with hazardous voltages, even if the power has been turned off. To avoid personal injury, do not remove the cover of the AC drive until all "DISPLAY LED" lights on the digital keypad are off. Please note that there are live components exposed within the AC drive. Do not touch these live parts.

WARNING: Ground the *DURAPULSE* AC Drive using the ground terminal. The grounding method must comply with the laws of the country where the AC drive is to be installed. Refer to "Basic Wiring Diagram" in CHAPTER 2.

WARNING: The mounting enclosure of the AC drive must comply with EN50178. Live parts shall be arranged in enclosures or located behind barriers that meet at least the requirements of the Protective Type IP20. The top surface of the enclosures or barrier that is easily accessible shall meet at least the requirements of the Protective Type IP40. Users must provide this environment for *DURAPULSE* Series AC Drive.

WARNING: The AC drive may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the AC drive output terminals T1, T2, and T3 directly to the AC main circuit power supply.

All DURApulse drives require a symmetrical 3-phase power source.
Do not connect them to grounded, center-tapped delta transformers of the type typically used for lighting circuits.

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DURAPULSE AC DRIVE USER MANUAL REVISION HISTORY

Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

Manual Number: **GS3-M**

Issue: **First Edition, Revision D**

Issue Date: **05/2013**

Publication History		
Issue	**Date**	**Description of Changes**
First Edition	12/08/2003	Original
First Edition, Revision A	2/26/2004	Corrected Watt loss information in Chapter One. Minor changes, corrections, and addtn'l information throughout.
First Edition, Revision B	06/2007	Minor changes and corrections throughout; Ch4 - New parameters & revised parameter explanations; Ch5 - New PLC program.
First Edition, Revision C	06/24/2011	Minor changes and corrections throughout. Ch2 – Wiring diagram & terminal spec modifications. Ch4 – Parameter description modifications (P2.10, P3.11-3.14, P6.00, P6.18, P9.04). Ch5 – PLC communication cable notes. AppxA – New accessories: LR-xxxx line reactors; 1-phase EMI filters; 1-phase fuses & blocks; GS-EDRV100; GS replacement cooling fans. AppxB – CLICK PLCs & connections.
First Edition, Revision D	05/2013	Minor changes and corrections throughout. Ch1 – New info for "Selecting the Proper Drive Rating." Ch2 – Storage conditions, capacitor recharge, and short-circuit information. Ch3 – Clarification of P4.00 in examples. Ch4 – New parameter info, especially for firmware v1.05; new analog input example. Ch5 – New and revised info regarding parameters, wiring and cabling, and CLICK and DirectLOGIC PLC programming. Ch6 – Storage conditions; capacitor recharge info. AppxA – Fusing and SCCR specs; *ZIP*Link™ GS cables. AppxB – New PLC components.

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CHAPTER 1

GETTING STARTED

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Manual Overview

Overview of this Publication

The *DURAPULSE* AC Drive User Manual describes the installation, configuration, and methods of operation of the *DURAPULSE* Series AC Drive.

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the GS3 Series AC Drives.

Supplemental Publications

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

15 Inverness Way East
Englewood, CO 80112-5776
1-800-854-7179 (within the U.S.)
303-397-7956 (international)
www.global.ihs.com

NEMA documents that might assist with your AC drive systems are:

- **Application Guide for AC Adjustable Speed Drive Systems**
- **Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.**

Technical Support

By Telephone: 770-844-4200
(Mon.-Fri., 9:00 a.m.-6:00 p.m. E.T.)
On the Web: www.automationdirect.com

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call technical support at **770-844-4200**. We are available weekdays from 9:00 a.m. to 6:00 p.m. Eastern Time.

We also encourage you to visit our web site where you can find technical and non-technical information about our products and our company. Visit us at **www.automationdirect.com**.

Special Symbols

When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note.

When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a WARNING. This information could prevent injury, loss of property, or even death (in extreme cases).

*DURA*PULSE AC Drive Introduction

Purpose of AC Drives

AC drives are generally known by many different names: Adjustable Frequency Drives (AFD), Variable Frequency Drives (VFD), and Inverters. Drives are used primarily to vary the speed of three phase AC induction motors, and they also provide non-emergency start and stop control, acceleration and deceleration, and overload protection. By gradually accelerating the motor, drives can reduce the amount of motor startup inrush current.

AC drives function by converting incoming AC power to DC, which is then synthesized back into three phase output power. The voltage and frequency of this synthesized output power is directly varied by the drive, where the frequency determines the speed of the three phase AC induction motor.

Selecting the Proper Drive Rating

A. Determine motor full-load amperage (FLA)

Motor FLA is located on the nameplate of the motor.
Note: FLA of motors that have been rewound may be higher than stated.

B. Determine motor overload requirements

Many applications experience temporary overload conditions due to starting requirements or impact loading. Most AC drives are designed to operate at 150% overload for 60 seconds. If the application requires an overload greater than 150% or longer than 60 seconds, the AC drive must be oversized.
NOTE: Applications that require replacement of existing motor starters with AC drives may require up to 600% overload.

C. Installation altitude

AC drives rely upon the cooling properties of air for cooling. As the altitude increases, the air becomes less dense, and this decrease in air density decreases the cooling properties of the air. Therefore, the AC drive must be oversized to compensate for the decrease in cooling. Most AC drives are designed to operate at 100% capacity up to altitudes of 1000 meters. Above 1000m, the AC drive must be derated.

D. Determine max enclosure internal temp

AC drives generate a significant amount of heat and will cause the internal temperature of an enclosure to exceed the rating of the AC drive, even when the ambient temperature is less than 104 °F (40 °C). Enclosure ventilation and/or cooling may be required to maintain a maximum internal temperature of 104 °F (40 °C) or less. Ambient temperature measurements/calculations should be made for the maximum expected temperature.

Selecting the Proper Drive Rating (continued)

E. Calculate required output amperage

Use the chart below to calculate the required FLA of the AC drive, as shown by the following examples. Select the rating that equals the motor's voltage and equals or exceeds the calculated amperage.

- Example 1 (GS1 or GS2 drive):
  Motor FLA = 6A; Overload = 200% @ 45s; Altitude = 800m; MEIT = 45°C
- Example 2 (*DURAPULSE* GS3 drive):
  Motor FLA = 8A; Overload = 135% @ 75s; Altitude = 1100m; MEIT = 35°C

Calculating Required Drive Current				
If		**Then Enter**	**Example 1 GS1 or GS2**	**Example 2 GS3 *DURAPULSE***
Overload Derate (overload %)				
If overload is < 150% and < 60 seconds		1	1.33	1.35
If overload is > 150% and < 60 seconds		(overload / 150)%		
If overload is > 60 seconds		(overload / 100)%		
Overload Result	Multiply FLA x overload entry		**8.0**	**10.8**
Altitude Derate (meters)				
Altitude is < 1,000m		1	1	1.01
Altitude is > 1,000m and < 3,000m		1 + ((altitude - 1,000m) x 0.0001)		
Altitude Result	Multiply overload result x altitude entry		**8.0**	**10.91**
Ambient Temperature (°C)				
Maximum enclosure internal temperature (MEIT) is < 40°C		1	1	1
40°C < MEIT < 50° and GS1/2 AC drive up to 5hp		1		
40°C < MEIT < 50° and GS1/2 AC drive > 5hp or *DURAPULSE* AC drive		1.2		
Required Drive FLA	Multiply altitude result x MEIT entry		**8.0**	**10.91**

Model Number Explanation

GS3 - 2 020

Applicable Motor Capacity

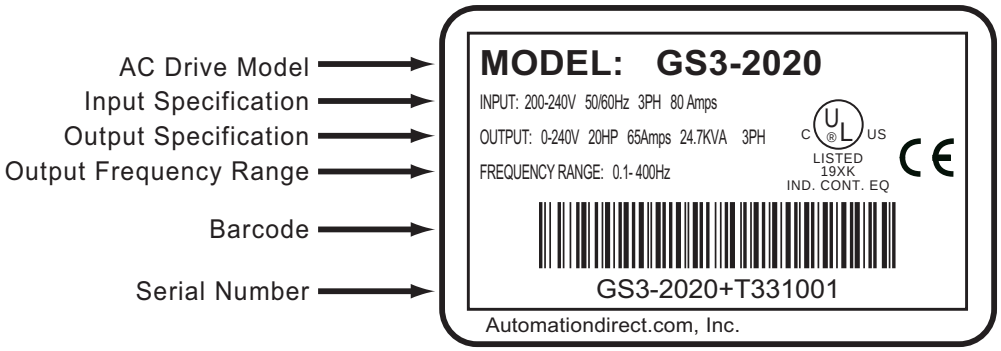
1P0: 1hp	2P0: 2hp	3P0: 3hp
5P0: 5hp	7P5: 7.5 hp	010: 10 hp
015: 15 hp	020: 20 hp	025: 25 hp
030: 30 hp	040: 40 hp	050: 50 hp
060: 60* hp	075: 75* hp	100: 100* hp

* 60, 75 and 100HP models available in GS3-4xxx only

Input Voltage
2: 200-240VAC
4: 380-480VAC

Series Name

Nameplate Information



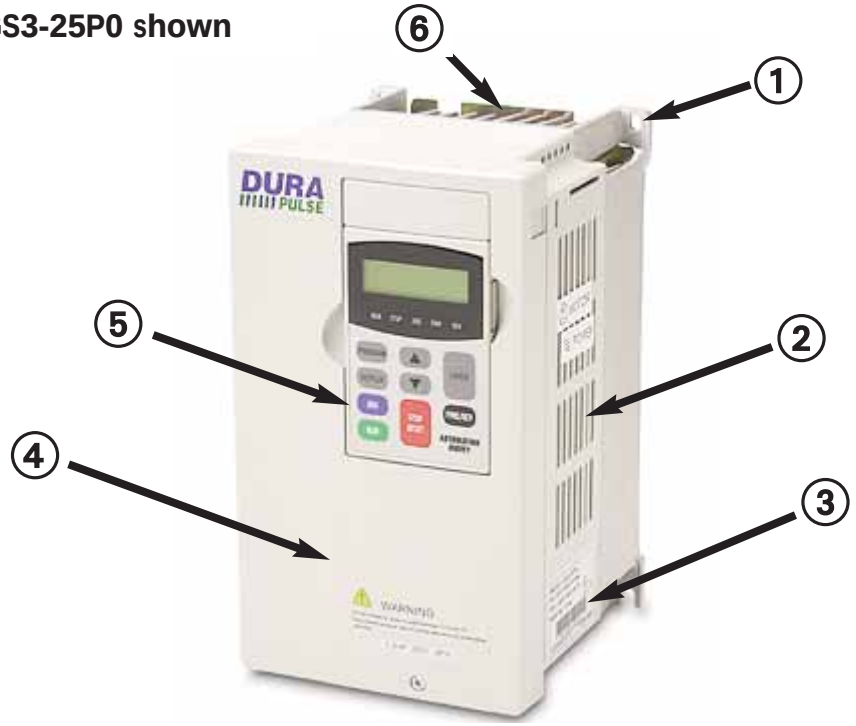
Drive Package Contents

After receiving the AC motor drive, please check for the following:

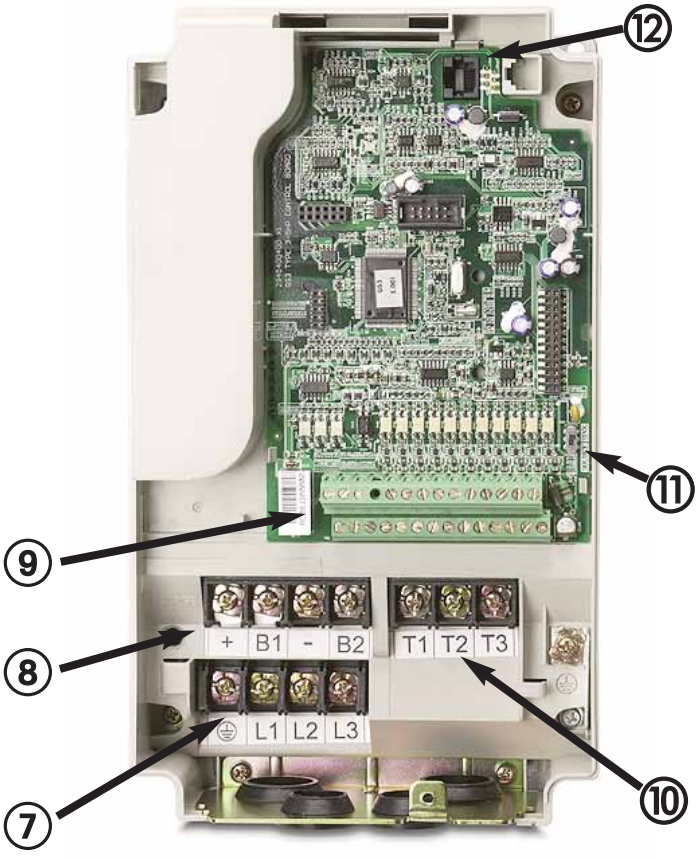
- Make sure that the package includes an AC drive, the *DURAPULSE* AC Drive User Manual, and the *DURAPULSE* AC Drive Quick Reference.
- Inspect the unit to insure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

External Parts and Labels

GS3-25P0 shown



① Mounting Screw Holes
② Ventilation Slots
③ Nameplate Label
④ Cover
⑤ Digital Keypad
⑥ Heat Sink Fins
⑦ Input Power Terminals
⑧ Braking Terminals
⑨ Control Terminals
⑩ Output Power Terminals
⑪ Input Mode Switch (Sink/Source)
⑫ Serial Communication Port



DURAPULSE AC Drive Specifications

Please review the AutomationDirect Terms and Conditions for this product.
*There is **no** 30-day money-back guarantee on any drive over 10 hp.*

230V Class							
Model Name: GS3-xxx			**21P0**	**22P0**	**23P0**	**25P0**	**27P5**
Output Rating	**Maximum Motor Output**	**hp**	1.0	2.0	3.0	5.0	7.5
		kW	0.75	1.5	2.2	3.7	5.5
	Rated Output Current (A)		5	7	11	17	25
	Maximum Output Voltage		Three-phase 200 to 240V (proportional to input voltage)				
	Rated frequency		0.1 to 400 Hz				
*** Input Rating**	**Rated Voltage/Frequency**		Single/Three-phase; 50/60 Hz; 200/208/220/230/240 VAC			Three-phase; 50/60 Hz; 200/208/220/230/240 VAC	
	Rated Input Current (A)		11.9 / 5.7	15.3 / 7.6	22 / 15.5	20.6	26
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%				
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 240 VAC				
Watt Loss 100% I (W)			60	82	130	194	301
Weight (lb [kg])			4.5 [2.034]	4.5 [2.034]	9.4 [4.24]	9.4 [4.24]	13.3 [6.031]

**** All 3-phase power sources must be symmetrical. Do not connect DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).***

230V Class (continued)									
Model Name: GS3-xxx			**2010**	**2015**	**2020**	**2025**	**2030**	**2040**	**2050**
Output Rating	**Maximum Motor Output**	**hp**	10	15	20	25	30	40	50
		kW	7.5	11	15	18.5	22	30	37
	Rated Output Current (A)		33	49	65	75	90	120	145
	Maximum Output Voltage		Three-phase 200 to 240V (proportional to input voltage)						
	Rated frequency		0.1 to 400 Hz						
*** Input Rating**	**Rated Voltage/Frequency**		Three-phase, 200/208/220/230/240 VAC; 50/60 Hz						
	Rated Input Current (A)		34	50	60	75	90	110	142
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%						
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 240 VAC						
Watt Loss 100% I (W)			380	660	750	920	1300	1340	1430
Weight (lb [kg])			13.3 [6.031]	14.3 [6.487]	26.5 [12]	26.5 [12]	26.5 [12]	77.2 [35]	77.2 [35]

**** All 3-phase power sources must be symmetrical. Do not connect DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).***

460V Class – Three Phase									
Model Name: GS3-xxx			**41P0**	**42P0**	**43P0**	**45P0**	**47P5**	**4010**	**4015**
Output Rating	**Maximum Motor Output**	**HP**	1	2	3	5	7.5	10	15
		kW	0.75	1.5	2.2	3.7	5.5	7.5	11
	Rated Output Current (A)		2.7	4.2	5.5	8.5	13	18	24
	Maximum Output Voltage		Three-phase 380 to 480V (proportional to input voltage)						
	Rated frequency		0.1 to 400 Hz						
*** Input Rating**	**Rated Voltage/Frequency**		Three-phase, 380/400/415/440/460/480VAC; 50/60 Hz						
	Rated Input Current (A)		3.2	4.3	5.9	11.2	14	19	25
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%						
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 480 VAC						
Watt Loss 100% I (W)			70	102	132	176	250	345	445
Weight (lb [kg])			3.9 [1.759]	4.4 [1.994]	4.1 [1.857]	9.4 [4.24]	13.2 [6.002]	13.5 [6.106]	14.4 [6.525]

**** All 3-phase power sources must be symmetrical. Do not connect DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).***

460V Class – Three Phase (continued)									
Model Name: GS3-xxx			**4020**	**4025**	**4030**	**4040**	**4050**	**4060**	**4075**	**4100**
Output Rating	**Maximum Motor Output**	**HP**	20	25	30	40	50	60	75	100
		kW	15	18.5	22	30	37	45	55	75
	Rated Output Current (A)		32	38	45	60	73	91	110	150
	Maximum Output Voltage		Three-phase 380 to 480V (proportional to input voltage)							
	Rated frequency		0.1 to 400 Hz							
*** Input Rating**	**Rated Voltage/Frequency**		Three-phase, 380/400/415/440/460/480; 50/60 Hz							
	Rated Input Current (A)		32	39	49	60	63	90	130	160
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%							
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 480 VAC					10 kA @ 480 VAC		
Watt Loss 100% I (W)			620	788	1290	1420	1680	2020	2910	3840
Weight (lb [kg])			26.5 [12]	26.5 [12]	26.5 [12]	77.2 [35]	77.2 [35]	77.2 [35]	116.8 [53]	116.8 [53]

**** All 3-phase power sources must be symmetrical. Do not connect DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).***

Please review the AutomationDirect Terms and Conditions for this product.
*There is **no** 30-day money-back guarantee on any drive over 10 hp.*

General Specifications			
Control Characteristics			
Control System			Pulse Width Modulation, Carrier frequency 1-15 kHz, adjustable, depending on the model. This system determines the control methods of the AC drive. 00: V/Hz open loop control, 01: V/Hz closed loop control, 02: Sensorless Vector 03: Sensorless Vector with external feedback
Rated Output Frequency			0.1 to 400.0 Hz
Output Frequency Resolution			0.1 Hz
Overload Capacity			150% of rated current for 1 minute
Torque Characteristics			Includes auto-torque boost, auto-slip compensation, starting torque 125% @ 0.5 Hz / 150% @ 1.0 Hz
Braking Torque			20% without dynamic braking, 125% with optional braking resistor (braking circuit built-in only for units under 20 hp)
DC Braking			Operation frequency 60-0 Hz, 0 - 100% rated current, Start time 0.0 - 5.0 seconds, Stop time 0.0 - 25.0 seconds
Acceleration/Deceleration Time			0.1 to 600 seconds (linear or non-linear acceleration/deceleration), second acceleration/deceleration available
Voltage/Frequency Pattern			Settings available for Constant Torque - low & high starting torque, Variable Torque - low & high starting torque, and user configured
Stall Prevention Level			20 to 200% of rated current
Operation Specification			
Inputs	**Frequency Setting**	**Keypad**	Setting by <UP> or <DOWN> buttons
		External Signal	Potentiometer - 3-5 kΩ, 0 to 10 VDC (input impedance 10 kΩ), 0 to 20 mA / 4 to 20 mA (input impedance 250Ω). Multi-Speed Inputs 1 to 4, RS-232C/RS-485 communication interface
	Operation Setting	**Keypad**	Setting by <RUN>, <STOP>, <JOG> buttons
		External Signal	Forward/Stop, Reverse/Stop (run/stop, fwd/rev), 3-wire control, Serial Communication RS-232C & RS-485 (Modbus RTU)
	Input Terminals	**Digital Sink/Source Selectable**	11 user-programmable: FWD/STOP, REV/STOP, RUN/STOP, REV/FWD, RUN momentary (N.O.), STOP momentary (N.C.), External Fault (N.O./N.C.), External Reset, Multi-Speed Bit (1-4), Manual Keyboard Control, Jog, External Base Block (N.O./N.C.), Second Accel/Decel Time, Speed Hold, Increase Speed, Decrease Speed, Reset Speed to Zero, PID Disable (N.O.), PID Disable (N.C.), Input Disable
		Analog	3 user-configurable, 0 to 10 VDC (input impedance 10 kΩ), 0 to 20mA / 4 to 20mA (input impedance 250Ω), 10 bit resolution -10V to +10V, 10 bit resolution
Outputs	**Output Terminals**	**Digital 3 transistors 1 relay**	4 user-programmable: Inverter Running, Inverter Fault, At Speed, Zero Speed, Above Desired Frequency, Below Desired Frequency, At Maximum Speed, Over Torque Detected, Above Desired Current, Below Desired Current, PID Deviation Alarm, Heatsink Overheat Warning (OH), Soft Braking Signal, Above desired Frequency 2, Below desired Frequency 2, Encoder Loss
		Analog	1 user-programmable, 0 to 10 VDC, 8 bit resolution frequency, current, process variable PV
	Operating Functions		Automatic voltage regulation, voltage/frequency characteristics selection, non-linear acceleration/deceleration, upper and lower frequency limiters, 15-stage speed operation, adjustable carrier frequency (1 to 15 kHz), PID control, 5 skip frequencies, analog gain & bias adjustment, jog, electronic thermal relay, automatic torque boost, trip history, software protection

General Specifications (cont.)		
Protective Functions		Electronic Thermal, Overload Relay, Auto Restart after Fault, Momentary Power Loss, Reverse Operation Inhibit, Auto Voltage Regulation, Over-Voltage Stall Prevention, Auto Adjustable Accel/Decel, Over-Torque Detection Mode, Over-Torque Detection Level, Over-Torque Detection Time, Over-Current Stall Prevention during Acceleration, Over-Current Stall Prevention during Operation
Operator Interface	**Operator Devices**	9-key, 2 line x 16 character LCD display, 5 status LEDs
	Programming	Parameter values for setup and review, fault codes
	Status Display	Output Frequency, Motor Speed, Scaled Frequency, Output Current, Motor Load, Output Voltage, DC Bus Voltage, PID Setpoint, PID Feedback, Frequency Setpoint
	Key Functions	RUN, STOP/RESET, FWD/REV, PROGRAM, DISPLAY, <UP>, <DOWN>, ENTER
Environment	**Enclosure Rating**	Protected Chassis, IP20
	Ambient Temperature	-10°C to 40°C (14°F to 104°F)
	Ambient Humidity	20 to 90% RH (non-condensing)
	Vibration	9.8 m/s^2 (1G) less than 10 Hz, 5.9 m/s^2 (0.6G) 10 to 60 Hz
	Installation Location	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Options		Noise filter, input AC reactor, output AC reactor, cable for remote operator, programming software, Dynamic braking resistor, input fuses

Installation and Wiring

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Ambient Conditions

Ambient environmental conditions for use:

Ambient Conditions	
Ambient Temperature	-10°C to 40°C (14°F to 104°F)
Relative Humidity	0 to 90% (non-condensing)
Atmosphere Pressure	86 kPa to 106 kPa
Vibration	9.8 m/s^2 (1G) less than 10 Hz, 5.9 m/s^2 (0.6G) 10 to 60 Hz
Installation Location	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Enclosure Rating	IP20: Protection against contact by fingers. Protection against medium-size foreign objects

Storage Conditions

The AC drives should be kept in their shipping cartons or crates until they are installed. In order to retain their warranty coverage, they should be stored as described below if they are not to be installed and used within three months.

- Store in a clean and dry location free from direct sunlight and corrosive fumes.
- For storage of longer than 3 months, store within an ambient temperature range of -20 °C to 30 °C (-4°F to 86°F).
- For storage of 3 months or less, store within an ambient temperature range of -20 °C to 60 °C (-4°F to 140°F).
- Store within a relative humidity range of 0% to 90% and non-condensing environment.
- Store within an air pressure range of 86 kPA to 106 kPA.
- DO NOT store in an area with rapid changes in temperature. (It may cause condensation and frost.)
- DO NOT place directly on the ground.

If the drive is stored or is otherwise unused for more than a year, the drive's internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year. (Refer to Chapter 6, "Maintenance and Troubleshooting" for information about recharging DC link capacitors.)

Installation

Install the AC drive in an enclosure that is specifically designed to house electrical and electronic control equipment. Provide proper spacing within the enclosure to allow the dissipation of heat produced by the drive and any other included electrical and electronic equipment. Ventilation or air conditioning may also be required, depending upon the application.

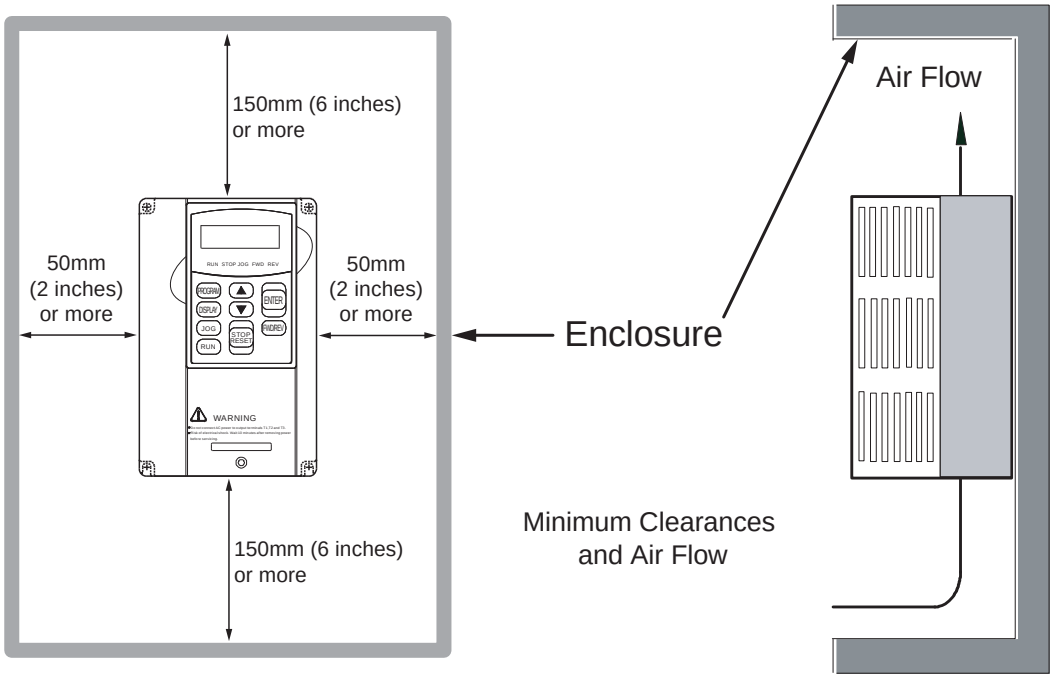
WARNING: Failure to observe these precautions may damage the drive and void the warranty!

Improper installation of the AC drive will greatly reduce its life. Observe the following precautions when installing the drive:

- Do not mount the AC drive near heat-radiating elements or in direct sunlight.
- Do not install the AC drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
- Mount the AC drive securely on a flat, rigid, non-flammable surface.
- Mount the AC drive vertically and do not restrict the air flow to the heat sink fins.

WARNING: AC drives generate a large amount of heat which may damage them. Auxiliary cooling methods are typically required in order not to exceed maximum ambient temperatures.

Minimum Clearances and Air Flow

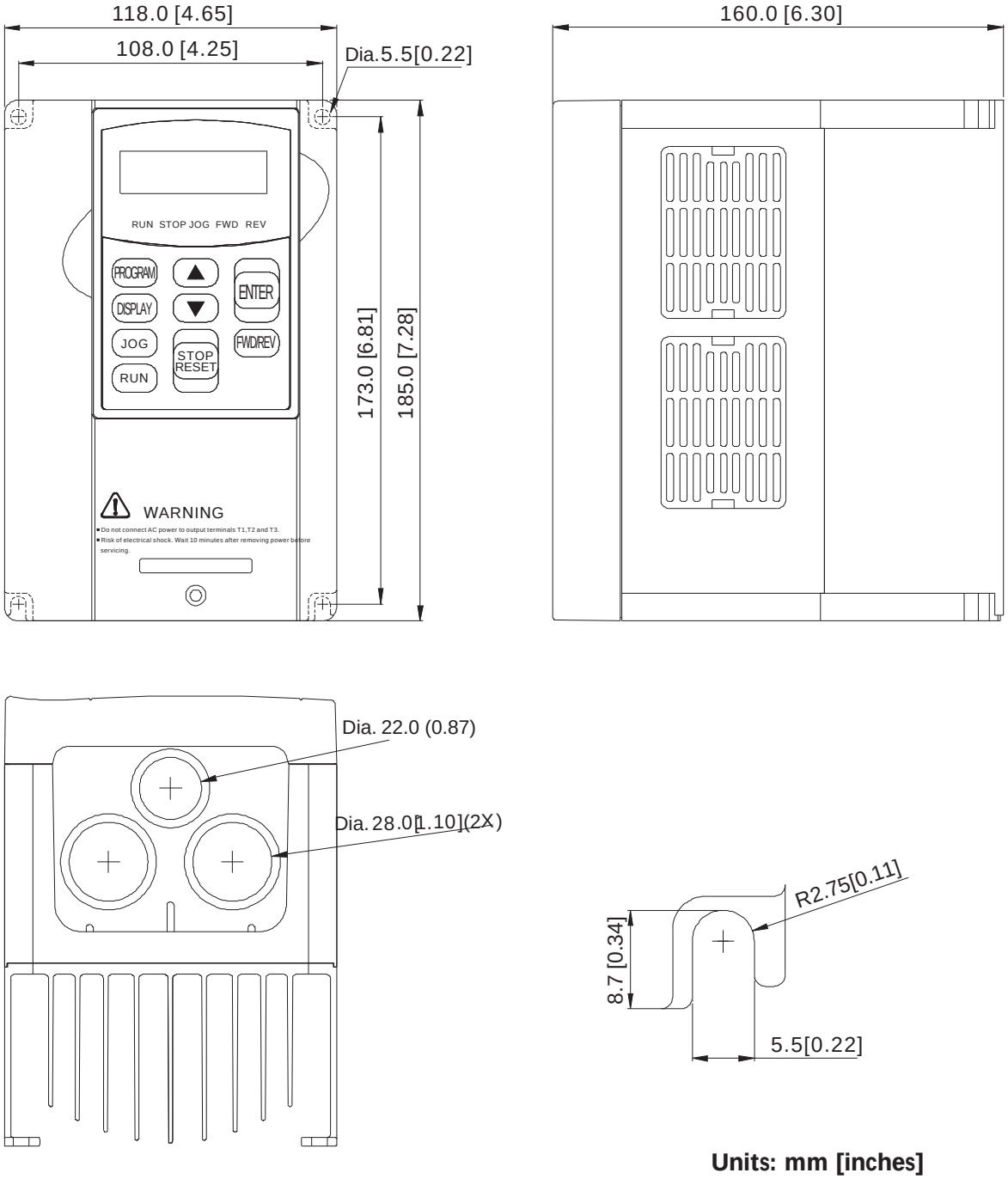


MAXIMUM AMBIENT TEMPERATURES MUST NOT EXCEED 40°C (104°F)!

Dimensions

Frame A

Part numbers: GS3-21P0, GS3-22P0, GS3-41P0, GS3-42P0

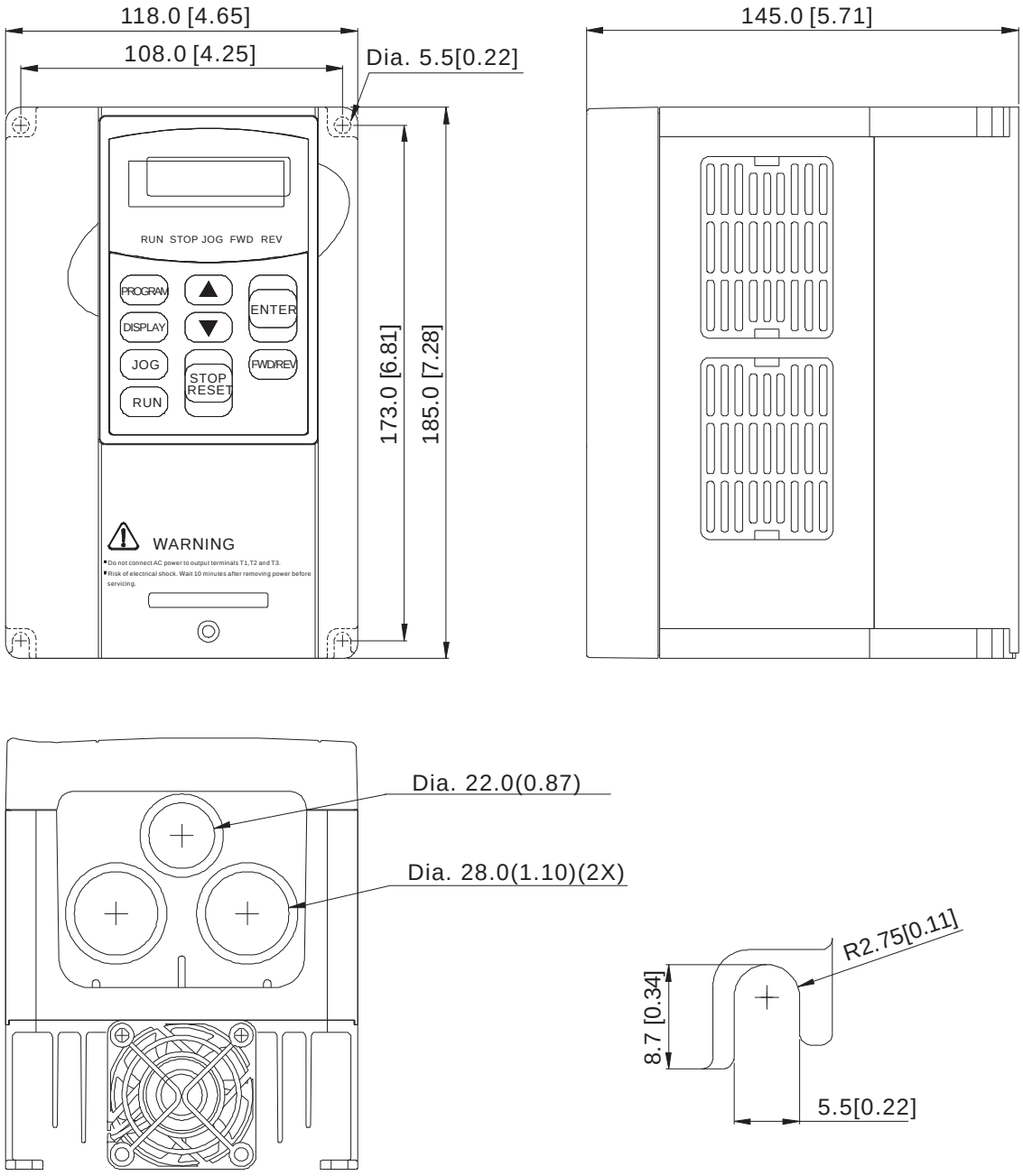


Units: mm [inches]

Dimensions (continued)

Frame A with Fan

Part Numbers: GS3-43P0

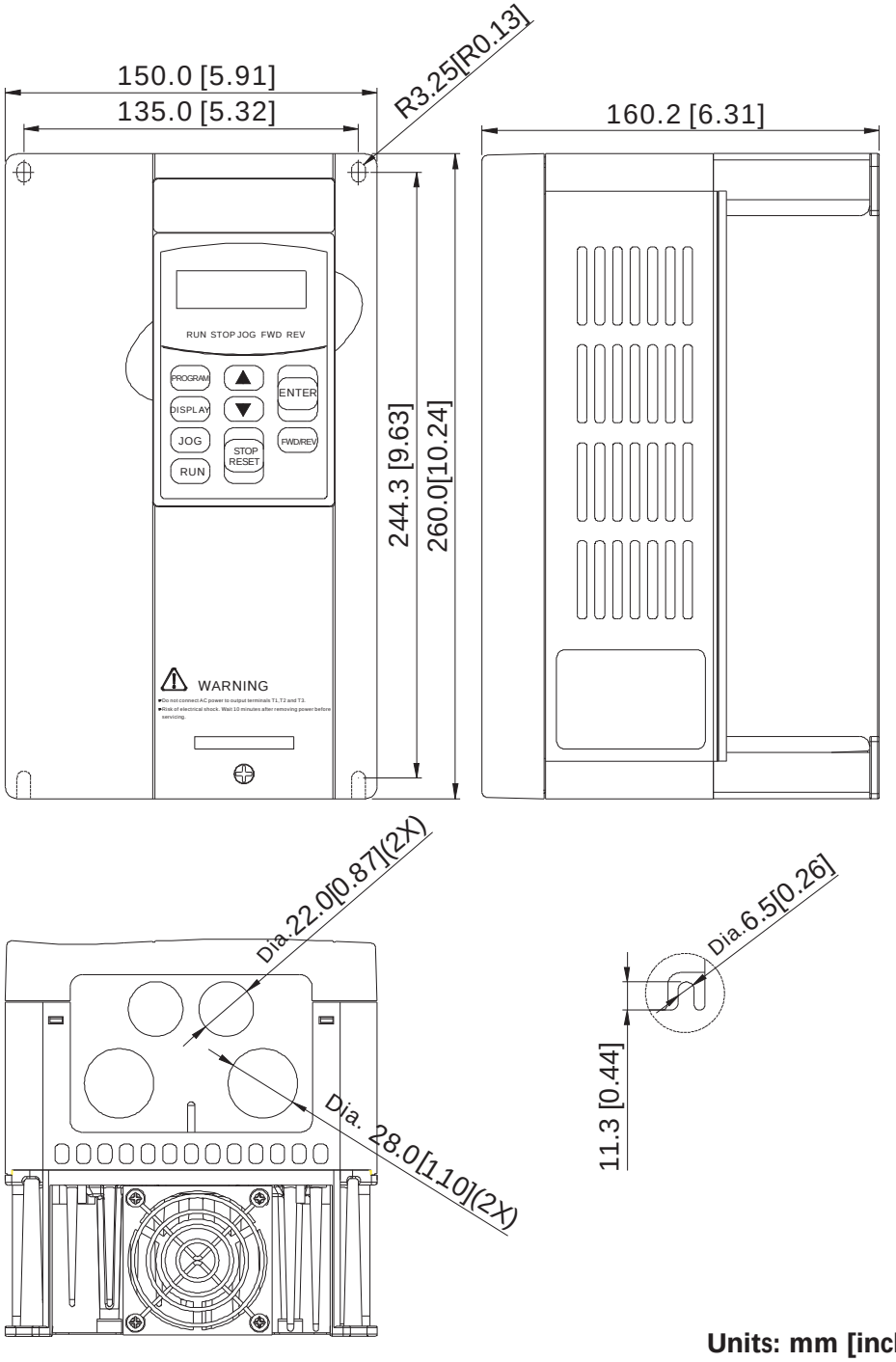


Units: mm [inches]

Dimensions (continued)

Frame B

Part numbers: GS3-23P0, GS3-25P0, GS3-45P0

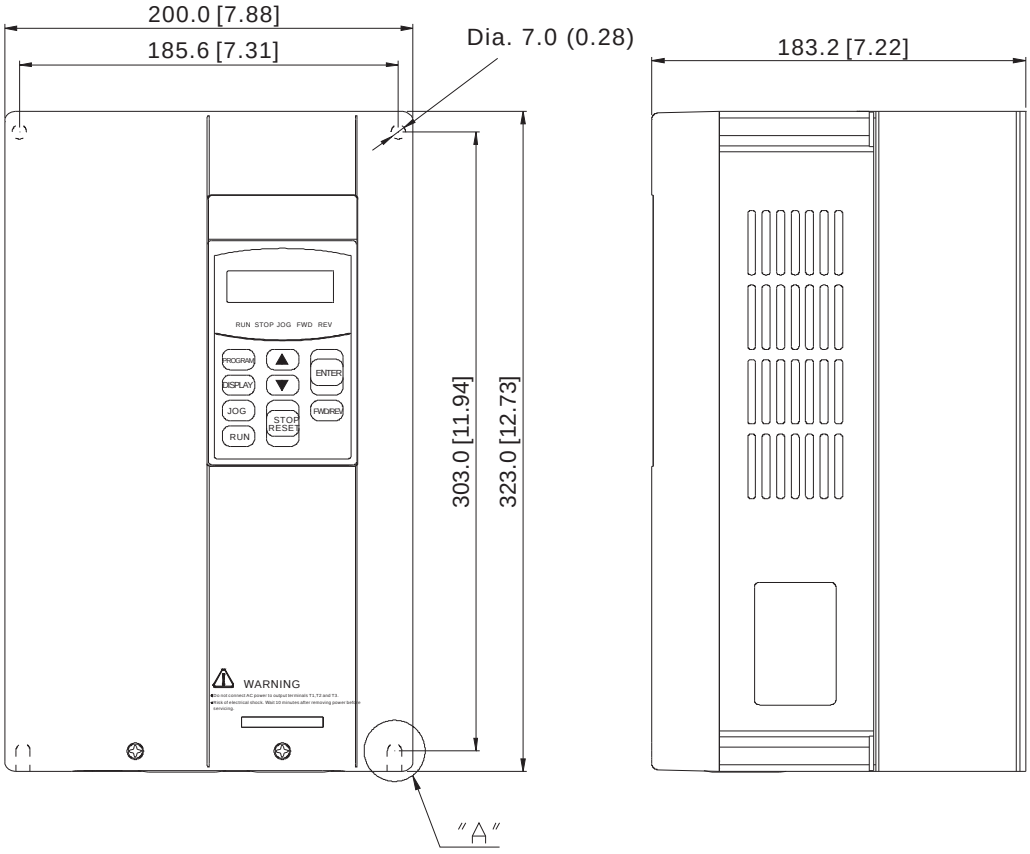


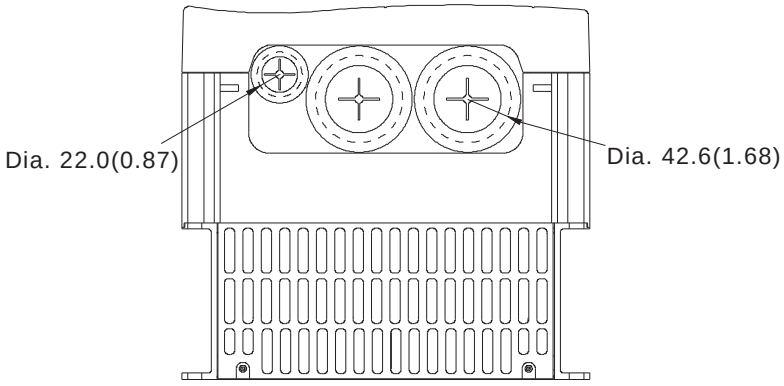
Units: mm [inches]

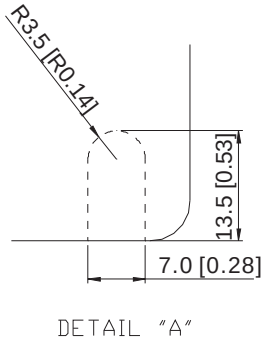
Dimensions (continued)

Frame C

Part numbers: GS3-27P5, GS3-2010, GS3-2015
GS3-47P5, GS3-4010, GS3-4015





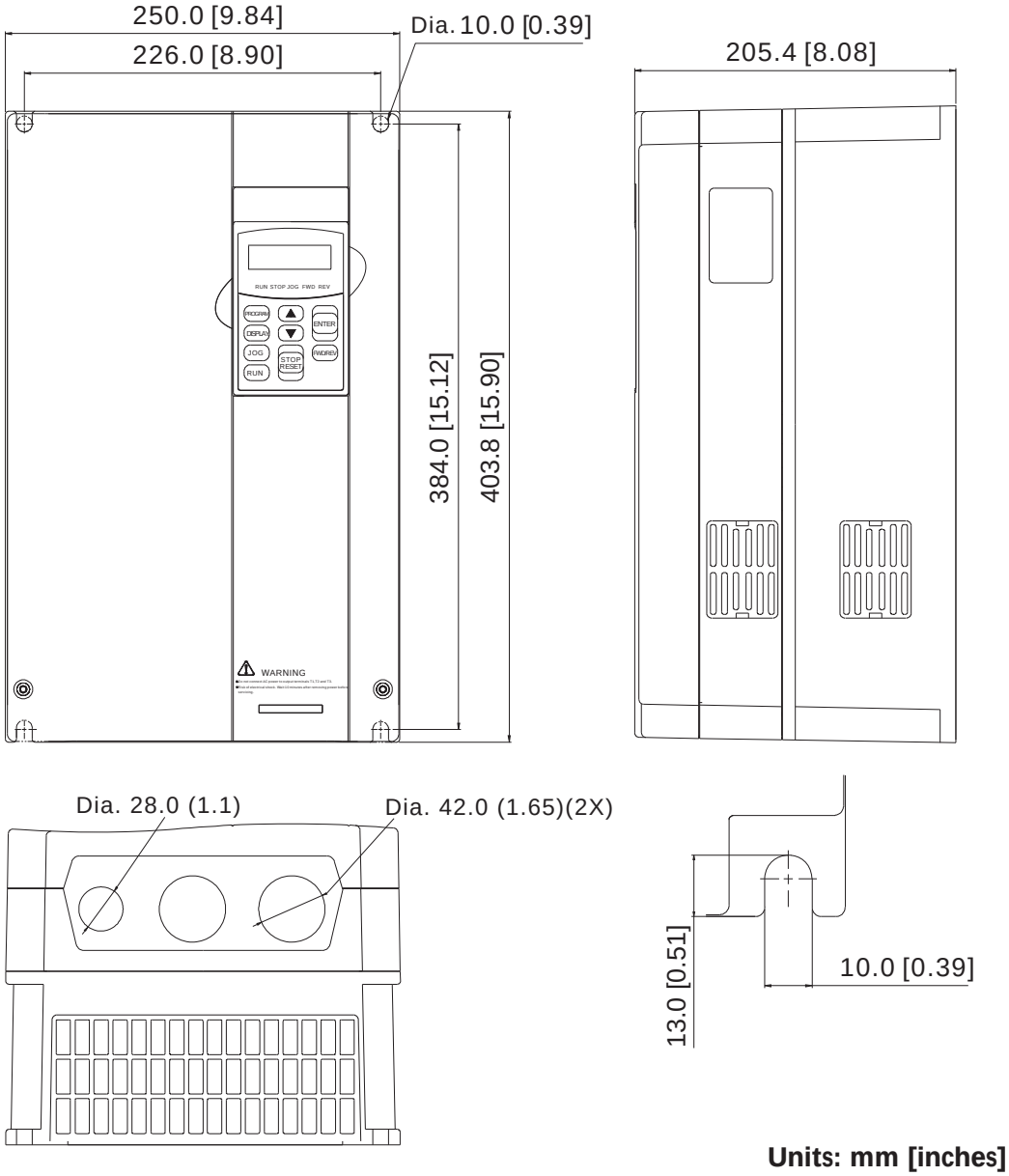


Units: mm [inches]

Dimensions (continued)

Frame D

Part numbers: GS3-2020, GS3-2025, GS3-2030
GS3-4020, GS3-4025, GS3-4030

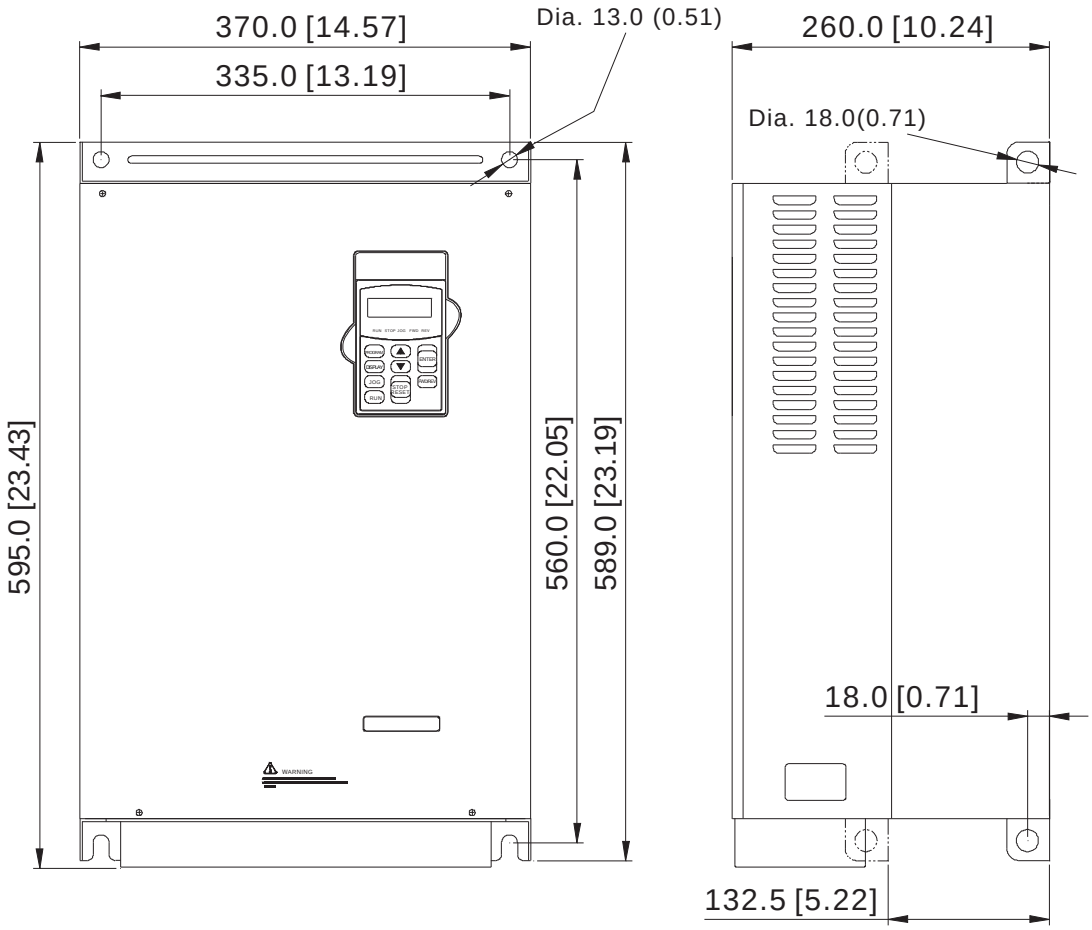


Units: mm [inches]

Dimensions (continued)

Frame E

Part Numbers: GS3-2040, GS3-2050
GS3-4040, GS3-4050, GS3-4060

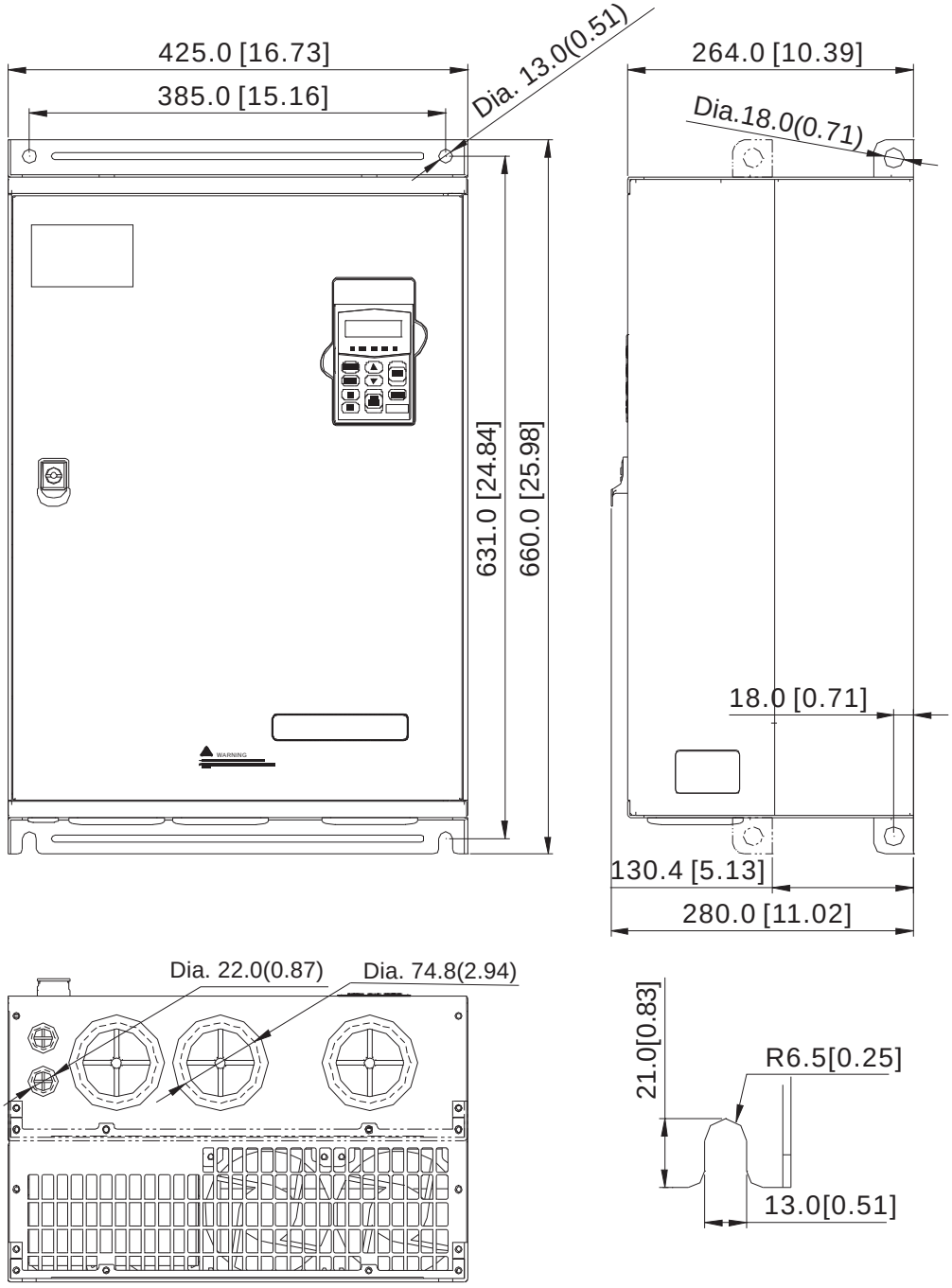


Units: mm [inches]

Dimensions (continued)

Frame F

Part Numbers: GS3-4075, GS3-4100



Units: mm [inches]

Circuit Connections

DANGER!

HAZARDOUS VOLTAGE! Before making any connection to the AC drive, disconnect all power to the AC drive, and wait five minutes for DC bus capacitors to discharge.

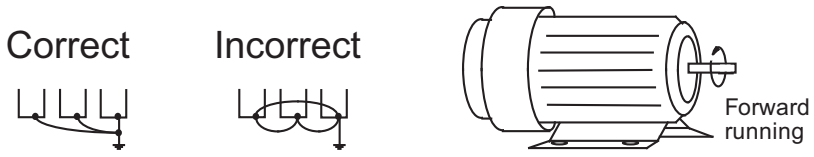
WARNING: Any electrical or mechanical modification to this equipment without prior written consent of AutomationDirect.com, Inc. will void all warranties, may result in a safety hazard, and may void the UL listing.

WARNING: Do not connect the AC input power to the T1, T2, and T3 output terminals. Doing this will damage the AC drive

WARNING: Tighten all screws to the proper torque rating. See "Main Circuit Wiring" later in this chapter.

Wiring Notes: PLEASE READ PRIOR TO INSTALLATION.

1. During installation, follow all local electrical, construction, and safety codes for the country in which the AC drive is to be installed.
2. Make sure the appropriate protective devices (circuit breaker or fuses) are connected between the power supply and AC drive.
3. Make sure that the leads are connected correctly and the AC drive is properly grounded. (Ground resistance should not exceed 0.1Ω.)
4. Use ground leads that comply with AWG/MCM standards and keep them as short as possible.
5. Do not use a power circuit contactor or disconnect switch for run/stop control of the AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.
6. Multiple *DURAPULSE* units can be installed in one location. All of the units should be grounded directly to a common ground terminal. The *DURAPULSE* ground terminals may also be connected in parallel, as shown in the figure below. **Make sure there are no ground loops.**



7. When the AC drive output terminals T1, T2, and T3 are connected to the motor terminals T1, T2, and T3, respectively, the motor will rotate counterclockwise (as viewed from the shaft end of the motor) when a forward operation command is received. To reverse the direction of motor rotation, switch the connections of any of the two motor leads.

8. Make sure that the power source is capable of supplying the correct voltage and required current to the AC drive.
9. Do not attach or remove wiring when power is applied to the AC drive.
10. Do not inspect components unless inside "POWER" lamp is turned off.
11. Do not monitor the signals on the circuit board while the AC drive is in operation.
12. GS3 series *DURAPULSE* drives **cannot be used with single-phase motors**.
13. Route the power and control wires separately, or at 90 degree angle to each other.
14. If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to the AC drive. EMI can also be reduced by lowering the Carrier Frequency.
15. If the AC drive is installed in a place where a load reactor is needed, install the filter close to the T1, T2, and T3 side of AC drive. Do not use a Capacitor, L-C Filter (Inductance-Capacitance), or R-C Filter (Resistance-Capacitance), unless approved by AutomationDirect.
16. When using a GFCI (Ground Fault Circuit Interrupt), select current sensor with sensitivity of 200mA, and not less than 0.1-second detection to avoid nuisance tripping.

Motor Operation Precautions

1. When using the AC drive to operate a standard 3-phase induction motor, notice that the energy loss is greater than for an inverter duty motor.
2. Avoid running a standard induction motor at low speed, which may cause the motor temperature to exceed the motor rating due to limited airflow produced by the motor's fan.
3. When the standard motor operates at low speed, the output load must be decreased.
4. If **100% output torque** is desired at low speed, it may be necessary to use a special **"inverter-duty" rated motor**.

Short Circuit Withstand (SCCR)

Models through 50 hp are suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes; 10,000A for models 60 hp through 100 hp. The maximum voltage is 240V for all 230V models, and 480V for all 460V models.

Applicable Codes

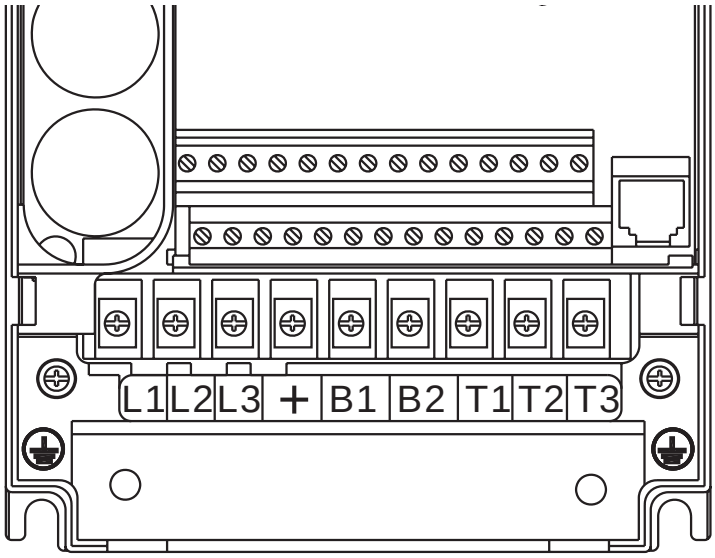
All *DURAPULSE* AC drives are Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL) listed, and therefore comply with the requirements of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

Installation intended to meet the UL and cUL requirements must follow the instructions provided in "Wiring Notes" as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC drive and the motor nameplate for electrical data.

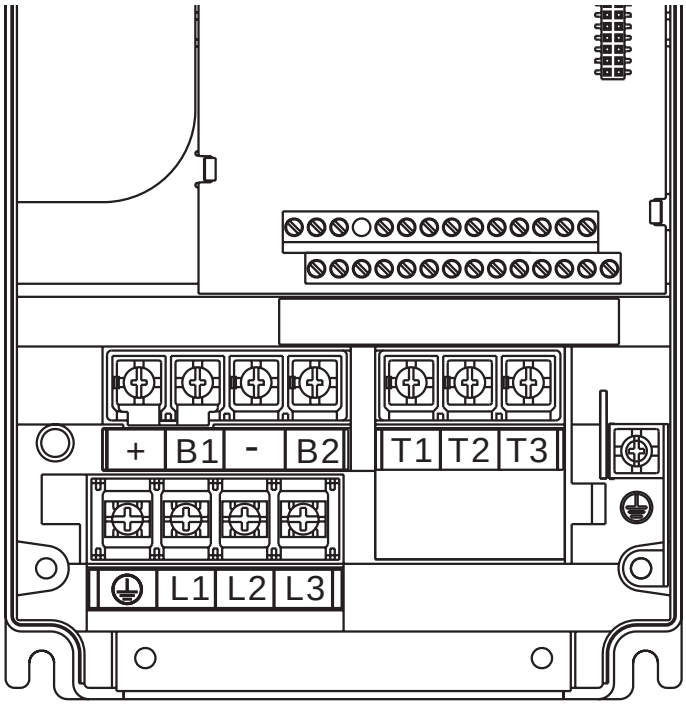
The "Circuit Protection Devices" section in APPENDIX A, lists the recommended fuse part number for each *DURAPULSE* part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is required.

Terminal Wiring Diagrams

GS3-21P0, GS3-22P0, GS3-41P0, GS3-42P0, GS3-43P0

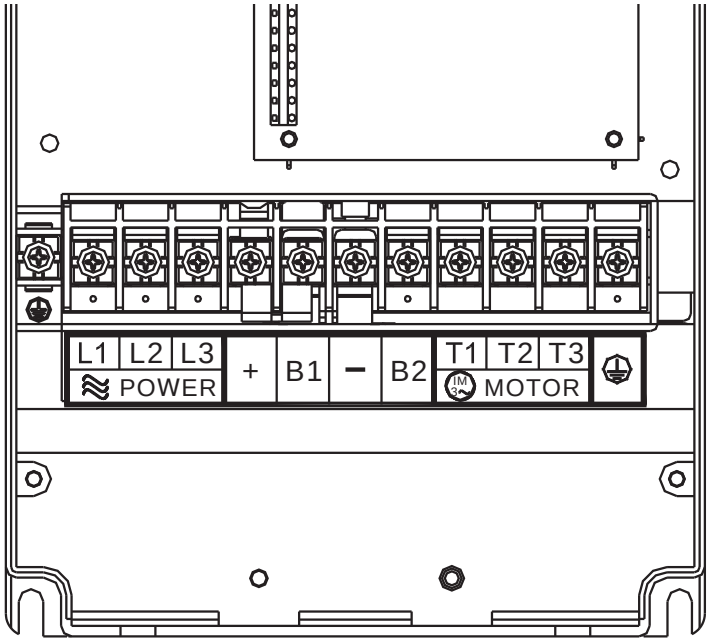


GS3-23P0, GS3-25P0, GS3-45P0

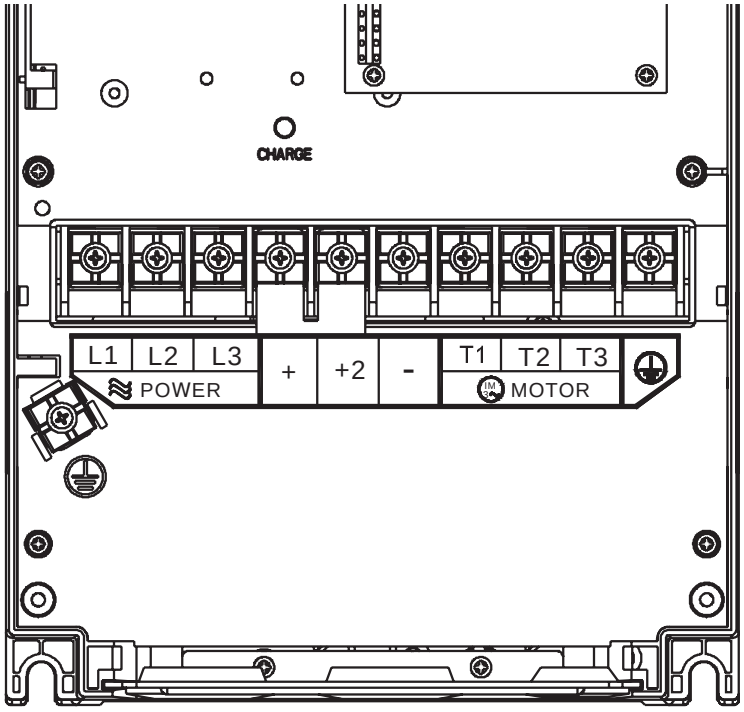


Terminal Wiring Diagrams (continued)

GS3-27P5, GS3-47P5, GS3-2010, GS3-4010, GS3-2015, GS3-4015

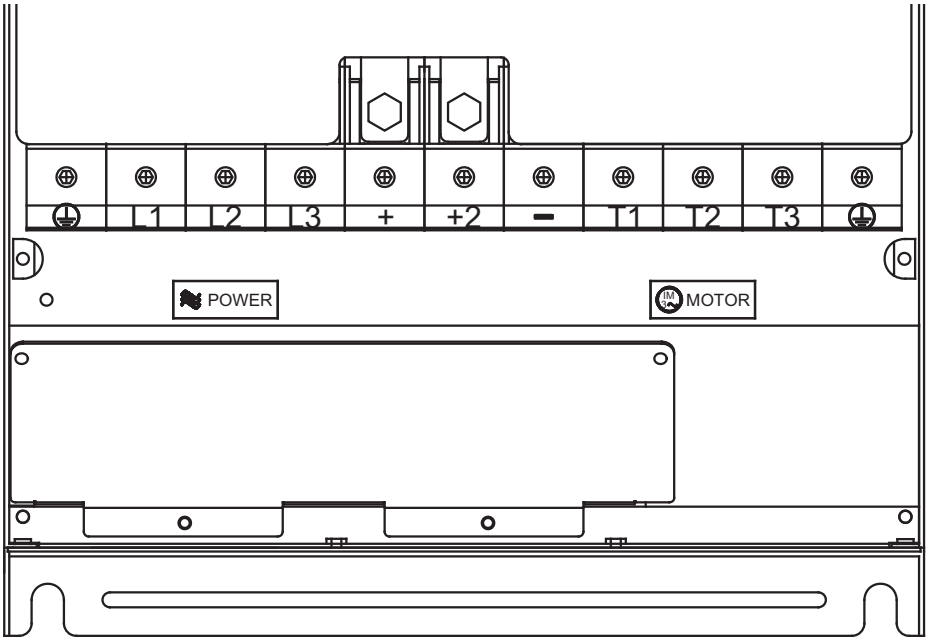


GS3-2020, GS3-4020, GS3-2025, GS3-4025, GS3-2030, GS3-4030

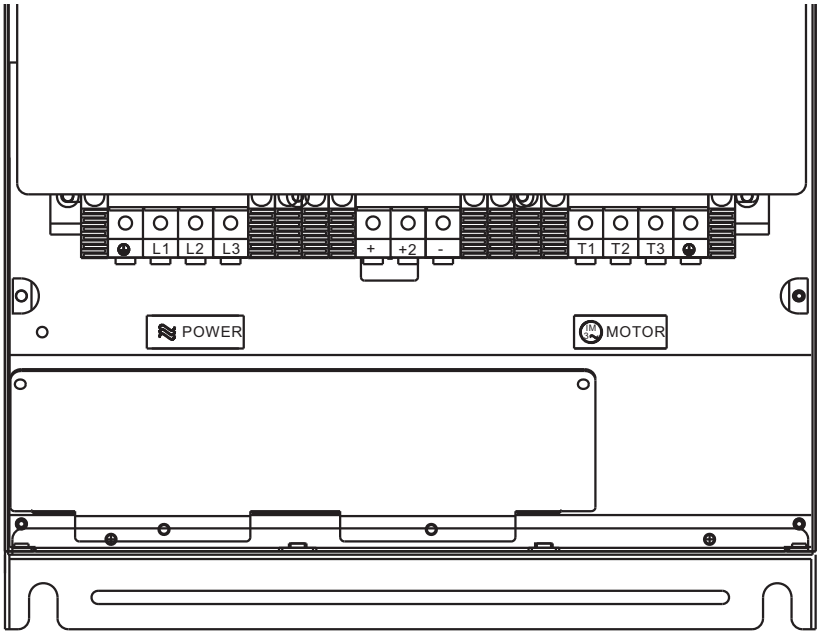


Terminal Wiring Diagrams (continued)

GS3-2040, GS3-2050

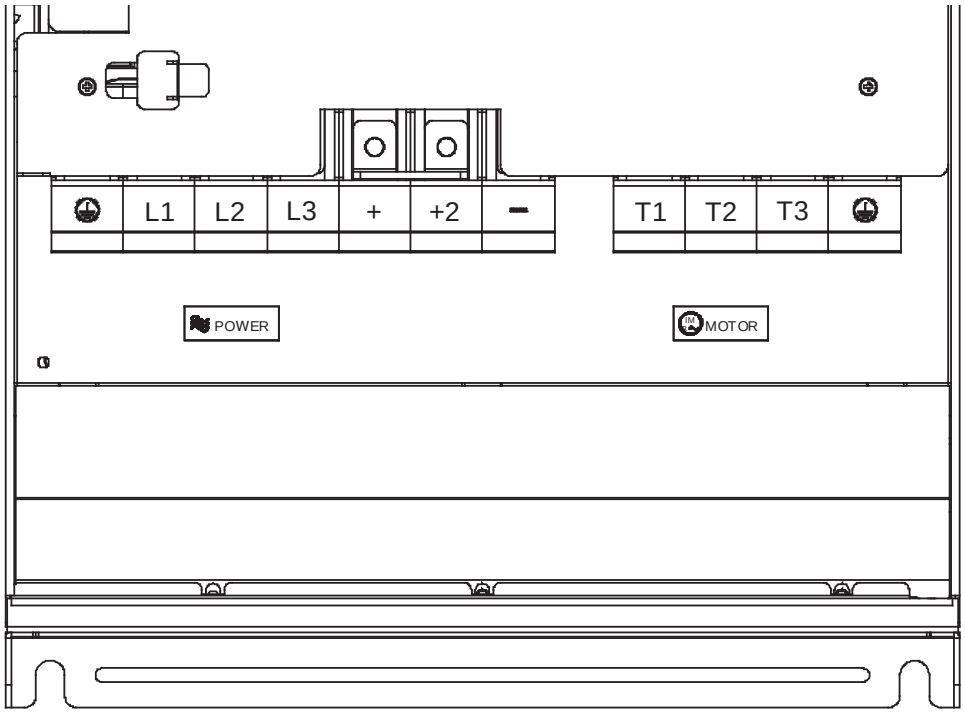


GS3-4040, GS3-4050,GS3-4060



Terminal Wiring Diagrams (continued)

GS3-4075, GS3-4100



Main Circuit Wiring

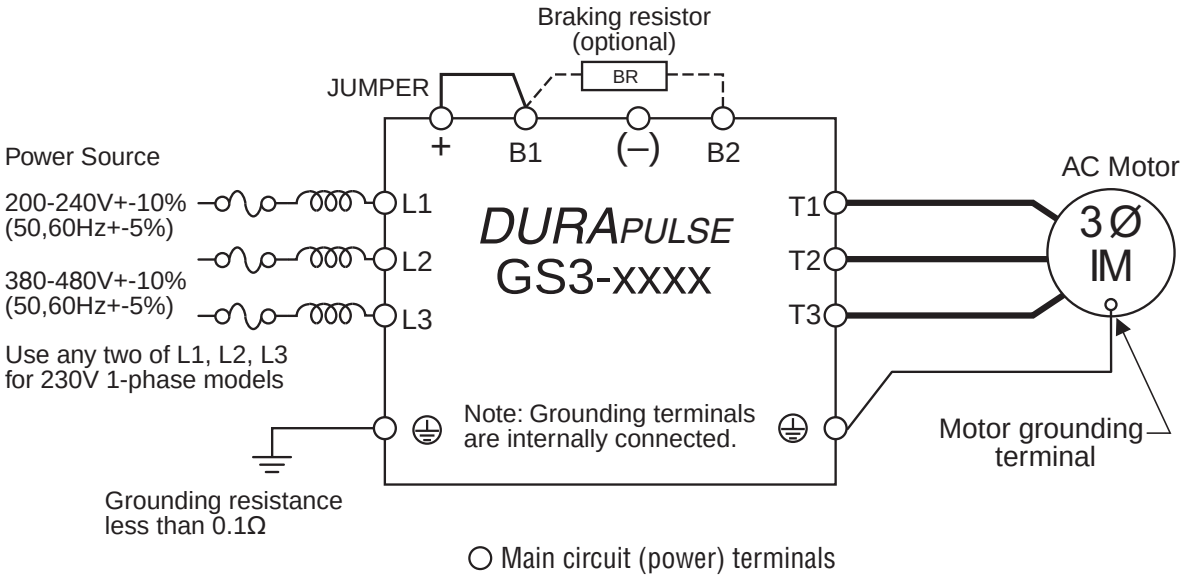
Main Circuit Terminals	
Terminal	Description
L1, L2, L3	Input Power
T1, T2, T3	AC Drive Output
B1, B2	Braking Resistor Connection (Under 20HP)
+2, – (negative)	External Dynamic Brake Unit (20HP & Over)
⏚	Ground

Main Circuit Wiring Specifications				
AC Drive Model	**Input Current (A)**	**Output Current (A)**	**Wire Range (AWG)**	**Terminal Tightening Torque (kgf-cm)**
GS3-21P0	5.7	5	10-18	18
GS3-22P0	7.6	7		
GS3-23P0	15.5	10		
GS3-25P0	20.6	17		
GS3-27P5	26	25	8-12	30
GS3-2010	34	33		
GS3-2015	50	49		40
GS3-2020	60	65	2-8	
GS3-2025	75	75		
GS3-2030	90	90		
GS3-2040	110	120	2/0-3/0	200
GS3-2050	142	145		
GS3-41P0	3.2	2.7	10-18	18
GS3-42P0	4.3	4.2		
GS3-43P0	5.9	5.5		
GS3-45P0	11.2	8.5		
GS3-47P5	14	13	8-12	30
GS3-4010	19	18		
GS3-4015	25	24		40
GS3-4020	32	32	2-8	
GS3-4025	39	38		
GS3-4030	49	45		
GS3-4040	60	60	2-4	57
GS3-4050	63	73		
GS3-4060	90	91		
GS3-4075	130	110	2/0-3/0	200
GS3-4100	160	150		

Power Wiring Diagrams

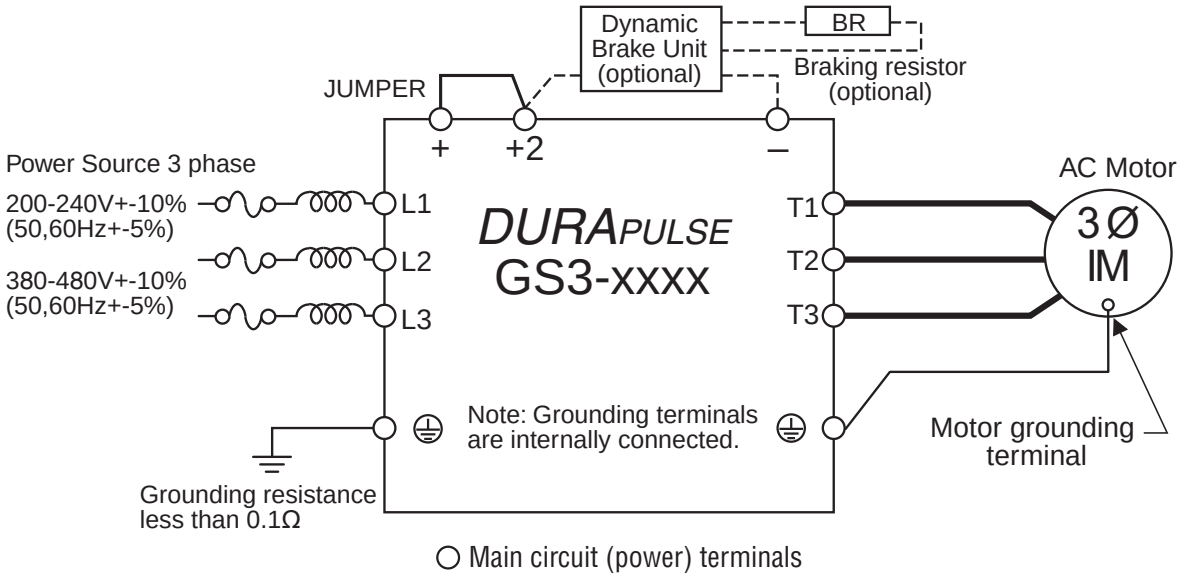
Drives under 20hp

Users must connect wiring according to the circuit diagram shown below.



Drives 20–30hp (230VAC) & 20–60hp (460VAC)

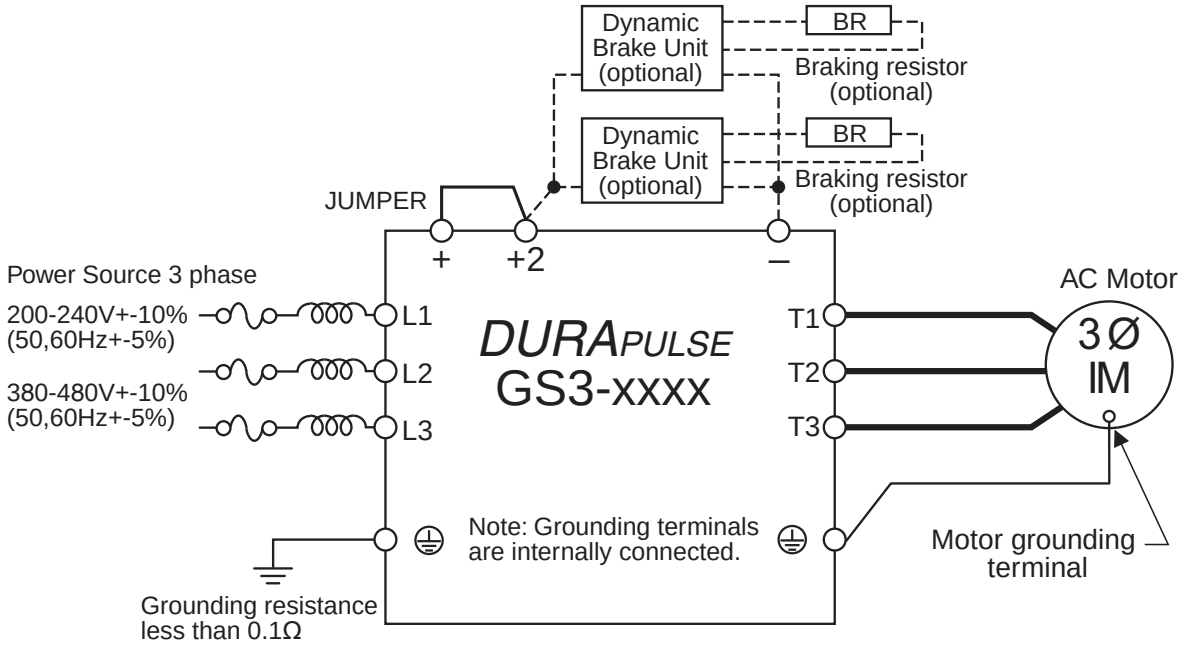
Users must connect wiring according to the circuit diagram shown below.



Power Wiring Diagrams (continued)

Drives 40–50hp (230VAC) & 75–100hp (460VAC)

Users must connect wiring according to the circuit diagram shown below.



Control Terminal Designations

Control Circuit Terminals		
Terminal Symbol	**Description**	**Remarks**
+24V	DC Voltage Source	(+24V, 20mA), used only for AC drive digital inputs wired for source mode operation
DI1	Digital Input 1	Input Voltage: Internally Supplied *(see WARNING below)* Sink Mode: Low active, Vin_L Min = 0V, Vin_L Max = 15V, Iin Min = 2.1mA, Iin Max = 7.0mA Source Mode: High active, Vin_H Min = 8.5V, Vin_H Max = 24V, Iin Min = 2.1mA, Iin Max = 7.0mA Input response: 12 - 15 msec Also see "Basic Wiring Diagram" on the next pages.
DI2	Digital Input 2	
DI3	Digital Input 3	
DI4	Digital Input 4	
DI5	Digital Input 5	
DI6	Digital Input 6	
DI7	Digital Input 7	
DI8	Digital Input 8	
DI9	Digital Input 9	
DI10	Digital Input 10	
DI11	Digital Input 11	
DCM	Digital Common	
+10V	Internal Power Supply	+10VDC (10mA maximum load)
AI1	Analog Input	0 to +10 V input only
AI2	Analog Input	0 to 20 mA / 4 to 20 mA input
AI3	Analog Input	-10 to +10 V input only
ACM	Analog Common	
R1O	Relay Output 1 Normally Open	Resistive Load: 240VAC – 5A (N.O) / 3A (N.C.) 24VDC – 5A (N.O.) / 3A (N.C.) Inductive Load: 240VAC – 1.5A (N.O) / 0.5A (N.C) 24VDC – 1.5A (N.O) / 0.5A (N.C)
R1C	Relay Output 1 Normally Closed	
R1	Relay Output 1 Common	
DO1	Photocoupled digital output	12-48 VDC, 50 mA
DO2	Photocoupled digital output	
DO3	Photocoupled digital output	
DOC	Digital Output Common	
FO	Digital Frequency Output	Maximum 50mA @ 48VDC, Scalable squarewave, 50% duty cycle output
AO	Analog Output	0 to +10V, 2mA Output
Control Terminal Wire Range: 24–12 AWG ***Control Terminal Tightening Torque: 5kgf·cm [4lbf·in]***		

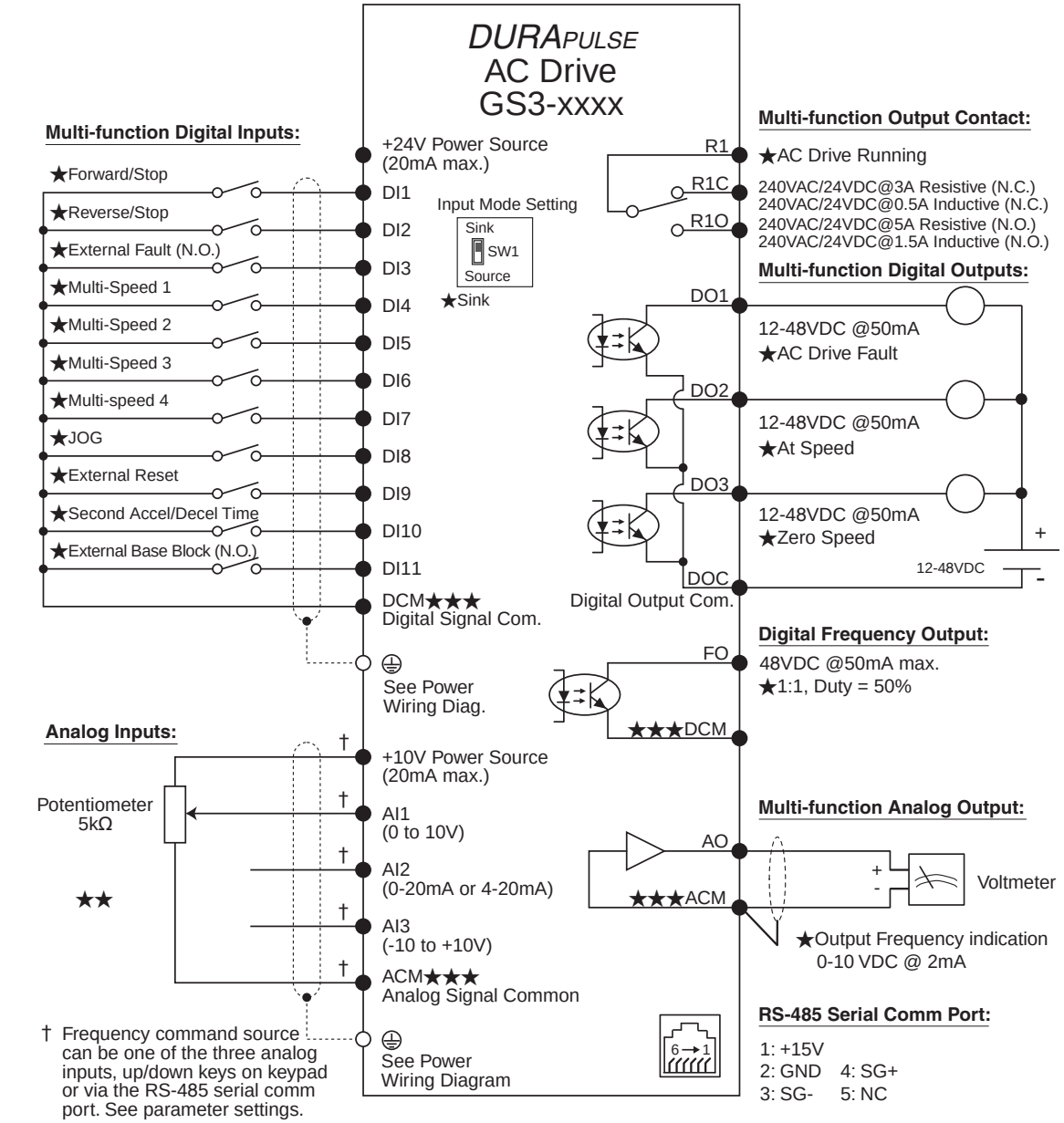
WARNING: Do NOT connect external voltage sources to the Digital Inputs. Permanent damage may result.

Use twisted-shielded, twisted-pair or shielded-lead wires for the control signal wiring. It is recommended to run all signal wiring in a separate steel conduit. The shield wire should only be connected at the AC drive. Do not connect shield wire on both ends.

Control Wiring Diagram – Sinking Inputs

Users must connect wiring according to the circuit diagram shown below.

WARNING: Do not plug a modem or telephone into the *DURAPULSE* RJ-12 Serial Comm Port, or permanent damage may result.



★ Factory default setting

★★ Factory default source of frequency command is via the keypad up/down keys

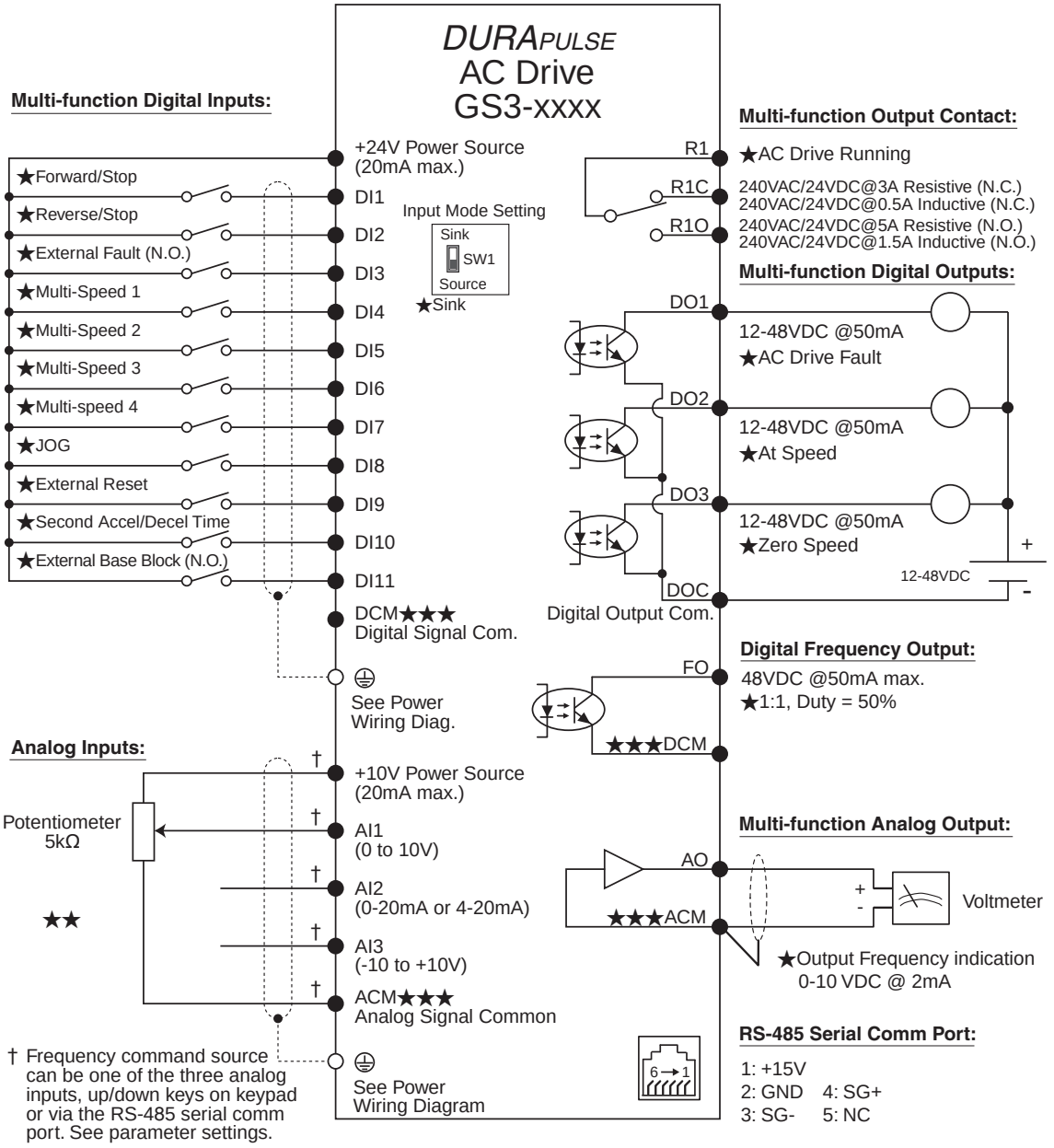
★★★ ACM and DCM are isolated from each other

○ Main circuit (power) terminals ● Control circuit terminal ⫩ Shielded leads

Control Wiring Diagram – Sourcing Inputs

Users must connect wiring according to the circuit diagram shown below.

WARNING: Do not plug a modem or telephone into the *DURAPULSE* RJ-12 Serial Comm Port, or permanent damage may result.



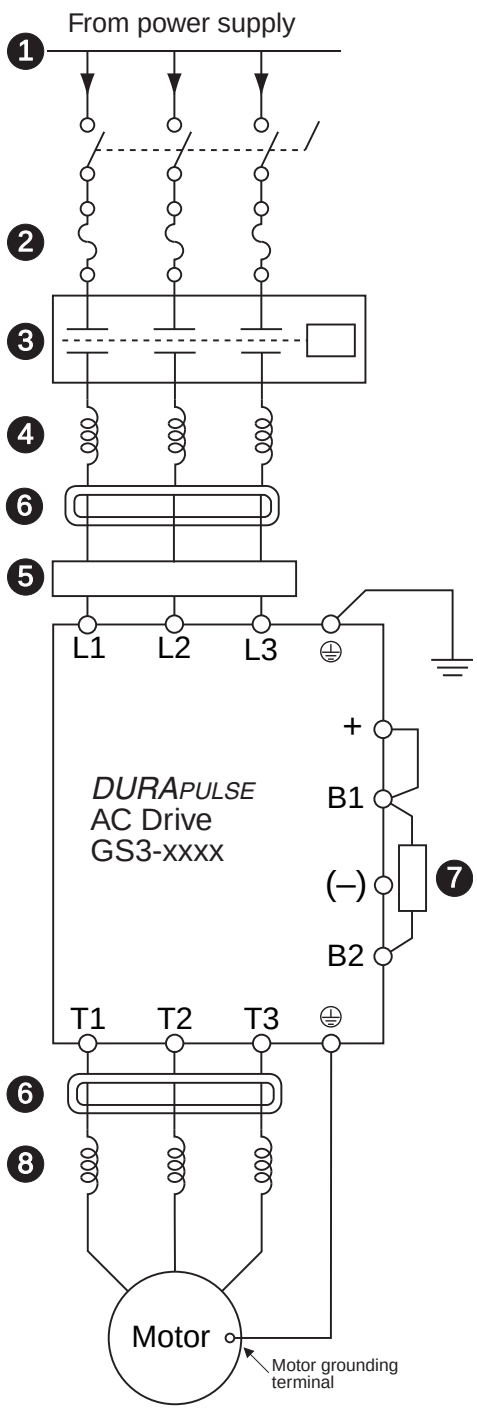
★ Factory default setting

★★ Factory default source of frequency command is via the keypad up/down keys

★★★ ACM and DCM are isolated from each other

○ Main circuit (power) terminals ● Control circuit terminal ⫩ Shielded leads

External Accessories



1 Power Supply
Please follow the specific power supply requirements shown in CHAPTER 1

2 Fuses
Input fuses protect the AC drive from excessive input current due to line surges, short circuits, and ground faults. They are recommended for all installations and may be required for UL-listed installations.

3 Contactor (Optional)
Do NOT use a power circuit contactor or disconnect switch for run/stop control of the AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.

4 AC Line Reactor (Optional)
Input line reactors protect the AC drive from transient overvoltage conditions typically caused by utility capacitor switching. Input line reactors also reduce harmonics associated with AC drives, and are recommended for all installations.

5 EMI filter (Optional)
Input EMI filters reduce electromagnetic interference or noise on the input side of the AC drive. They are required for CE compliance and recommended for installations prone to or sensitive to electromagnetic interference.

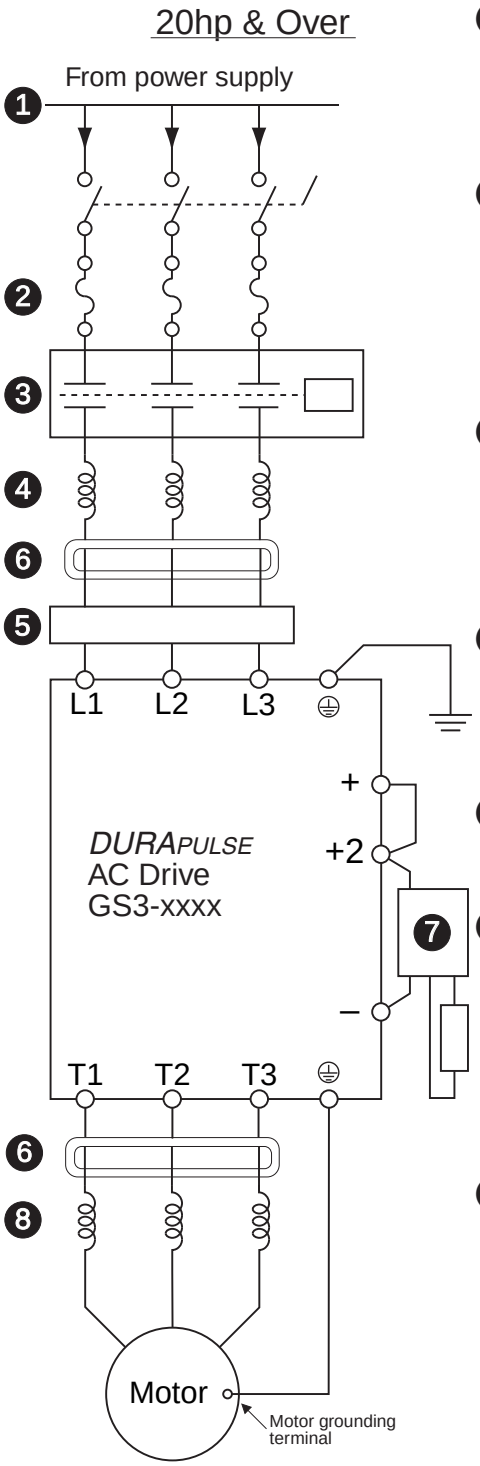
6 RF filter (Optional)
RF filters reduce the radio frequency interference or noise on the input or output side of the inverter.

7 Braking Resistor (Optional)
Dynamic braking allows the AC drive to produce additional braking (stopping) torque. AC drives can typically produce between 15% & 20% braking torque without the addition of any external components. Optional braking may be required for applications that have high inertia loads or require rapid deceleration.

8 AC Line Reactor (Optional)
Output line (load) reactors protect the motor insulation against AC drive short circuits and IGBT reflective wave damage, and also “smooth” the motor current waveform, allowing the motor to run cooler. They are recommended for operating “non-inverter-duty” motors, and when the length of wiring between the AC drive and motor exceeds 75ft.

Please refer to Appendix A for specifications on DURAPULSE AC Drive Accessories.

External Accessories (continued)



1 Power Supply
Please follow the specific power supply requirements shown in CHAPTER 1

2 Fuse
Input fuses protect the AC drive from excessive input current due to line surges, short circuits, and ground faults. They are recommended for all installations and may be required for UL-listed installations.

3 Contactor (Optional)
Do NOT use a power circuit contactor or disconnect switch for run/stop control of the AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.

4 AC Line Reactor (Optional)
Input line reactors protect the AC drive from transient overvoltage conditions typically caused by utility capacitor switching. Input line reactors also reduce harmonics associated with AC drives, and are recommended for all installations.

5 EMI filter (Optional)
Input EMI filters reduce electromagnetic interference or noise on the input side of the AC drive. They are required for CE compliance and recommended for installations prone to or sensitive to electromagnetic interference.

6 RF filter (Optional)
RF filters reduce the radio frequency interference or noise on the input or output side of the inverter.

7 Braking Unit and Braking Resistor (Optional)
Dynamic braking allows the AC drive to produce additional braking (stopping) torque. AC drives can typically produce between 15% & 20% braking torque without the addition of any external components. Optional braking may be required for applications that have high inertia loads or require rapid deceleration.

8 AC Line Reactor (Optional)
Output line (load) reactors protect the motor insulation against AC drive short circuits and IGBT reflective wave damage, and also “smooth” the motor current waveform, allowing the motor to run cooler. They are recommended for operating “non-inverter-duty” motors, and when the length of wiring between the AC drive and motor exceeds 75ft.

Please refer to Appendix A for specifications on DURAPULSE AC Drive Accessories.

CHAPTER 3

KEYPAD OPERATION AND QUICKSTART

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- LED Indicators 3–2
- Function Keys 3–3
- Displaying the Status of the *DURAPULSE* AC Drive 3–4
- Programming the *DURAPULSE* AC Drive 3–5

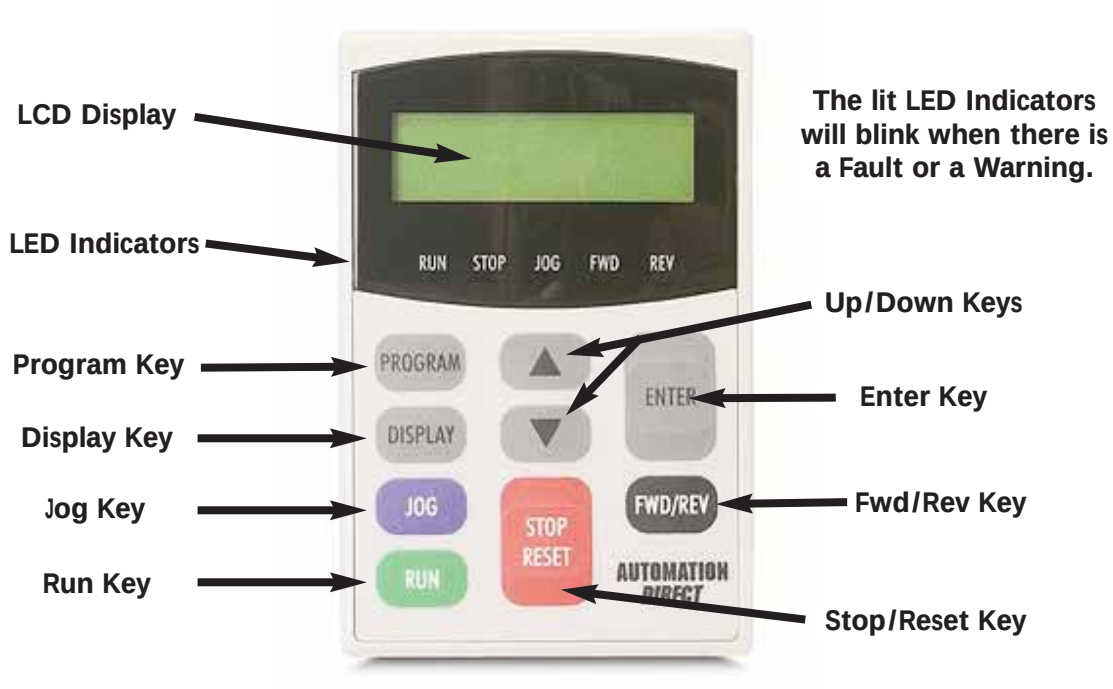
DURAPULSE Quickstart 3–6
- Example 1: Constant torque (e.g. conveyors, compressors, etc.) 3–6
- Example 2: Variable torque (e.g. fans, centrifugal pumps, etc.) 3–10

Auto-Tune Procedure 3–14

Copy Keypad Function 3–16
- Enable Copy Keypad Function 3–16
- Write Parameter Settings to Keypad 3–17
- Write Parameter Settings to Drive 3–18

The *DURAPULSE* Digital Keypad

The digital keypad includes a 2 line x 16 character LCD display, 5 status LED Indicators, and 9 function keys. The diagram below shows all of the features of the digital keypad and an overview of their functions.



LCD Display

The LCD Display shows the operation values and parameter settings of the AC drive.

LED Indicators

RUN The RUN LED indicates the AC drive is in Run Mode.

STOP The STOP LED indicates the AC drive is not in Run Mode.

FWD The FWD LED indicates the AC drive is running the motor in the forward direction.

REV The REV LED indicates the AC drive is running the motor in the reverse direction.

JOG The JOG LED indicates the AC drive is in the Jog Mode.

If the STOP key on the keypad is active and the keypad is removed, the drive will stop.

Function Keys

Program Key

Pressing the PROGRAM key will display the parameter groups. Use the UP/DOWN or PROGRAM keys to cycle through the parameter groups. The LCD display will show which parameter group is currently selected.

Display Key

Pressing the DISPLAY key on the keypad repeatedly will cycle through the status messages on the AC drive.

Fwd/Rev Key

Pressing the FWD/REV key changes the direction in which the motor operates.

Run

Pressing the RUN key starts the AC drive operation. This key has no function if the AC drive is controlled by the external control terminals.

Up/Down Keys

The UP/DOWN keys are used to scroll through the parameter groups, the various parameters in each group and also change the parameter settings in single-unit increments. To quickly run through the range of settings, press and hold the UP or DOWN key.

Enter Key

Press the ENTER key to view parameters and store parameter settings.

Stop/Reset Key

Used to stop AC drive operation. If the AC drive has stopped due to a fault, clear the fault first, then press this key to reset the AC drive.

Jog Key

Pressing the JOG key controls the jog function.

After a one (1) minute key inactivity, the keypad LCD display will automatically revert to the display mode and display the user defined display function selected in parameter P8.00.

Adjust Frequency Setpoint

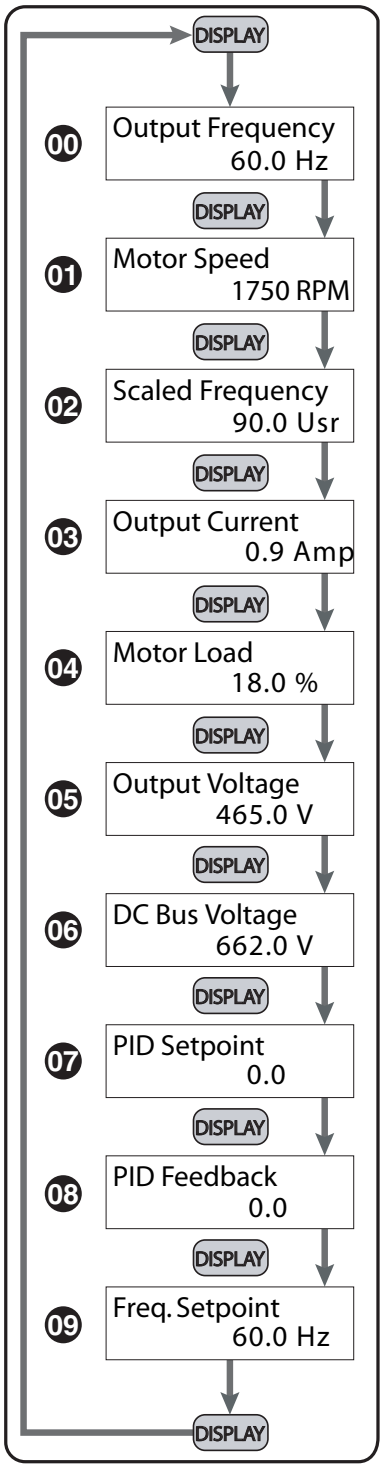
If the UP and DOWN keys are pressed when the LCD is in DISPLAY mode and the AC drive frequency is being controlled by the keypad (P4.00=1), then the keypad will display the frequency setpoint and have the ability to adjust the frequency setpoint with the UP/DOWN keys accordingly. The frequency setpoint will be stored even if the drive is powered off.

Adjust PID Setpoint

The ability to adjust the PID setpoint with the UP and DOWN keys will be true if parameter P7.00 is set to a value of 01, 02, 03, or 04, parameter P7.02 = 00 and the LCD display shows the PID setpoint.

Displaying the Status of the *DURAPULSE* AC Drive

Press the DISPLAY key on the keypad repeatedly to cycle through the status messages on the AC drive. The diagram below shows the order of the status messages as you cycle through them and shows the definition of the status messages. The status of the AC drive can be shown in RUN or STOP mode.



00 Actual Operating Frequency
Displays the actual operating frequency present at the T1, T2, and T3 terminals. *Example: 60.0Hz*

01 RPM
Displays the present *estimated* speed of the motor. *Example: 1750 RPM*

02 Scaled Frequency
Displays the result of output frequency x parameter P8.01. *Example: 60Hz x 1.5 = 90.0*

03 Amps
Displays the output current present at the T1, T2, and T3 terminals. *Example: 0.9A*

04 % Motor Load
Displays the amount of load on the AC drive.
Example: (Output Current ÷ Drive Rated Current) x 100

05 Output Voltage
Displays the output voltage present at the T1, T2, and T3 terminals. *Example: 465V*

06 DC Bus Voltage
Displays the DC Bus Voltage. *Example: 662 VDC*

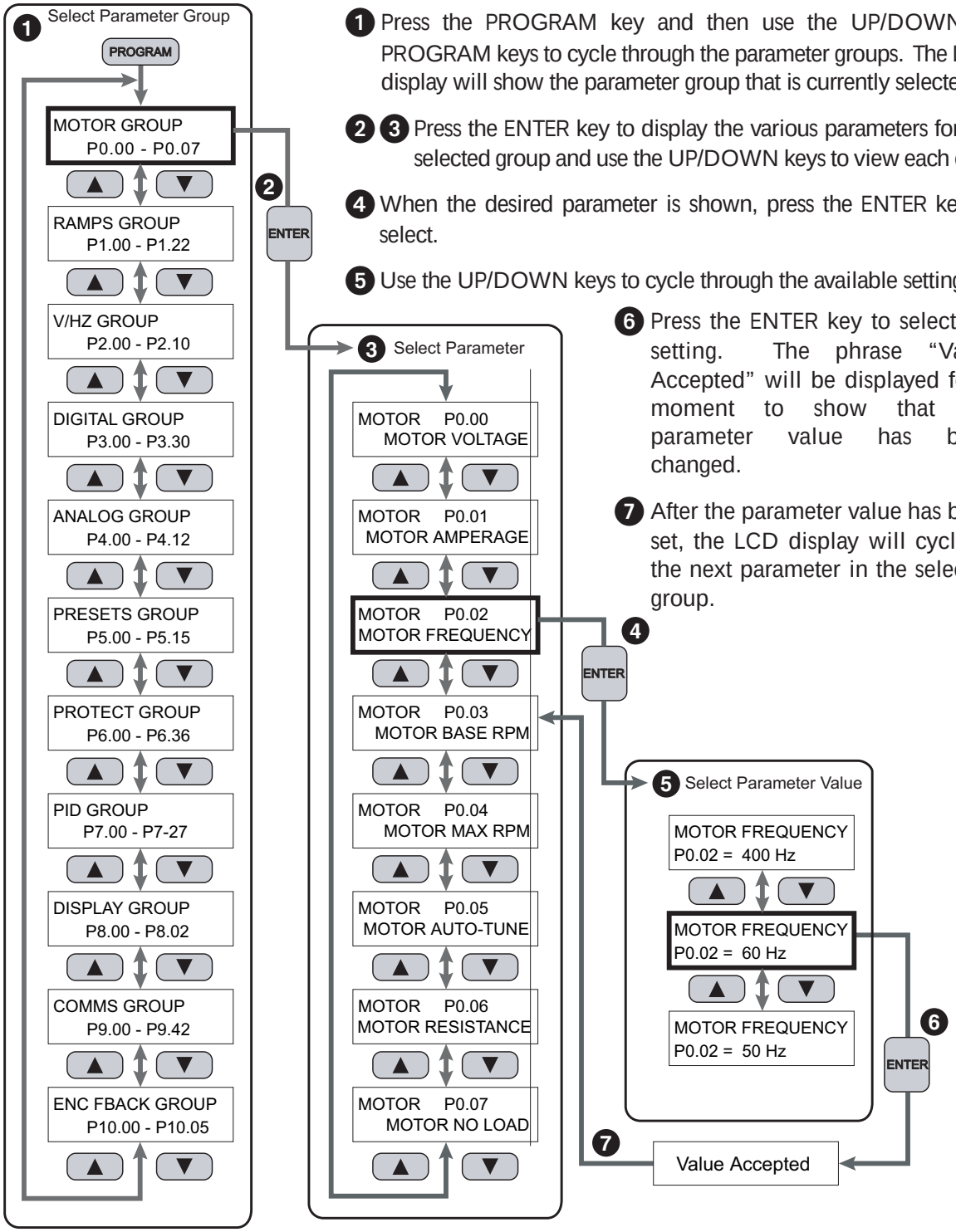
07 PID Setpoint
Displays the PID setpoint. *Note: It is possible to change the PID setpoint with the ▲ and ▼ keys when the PID setpoint value is displayed on the keypad. The PID function (P7.00) must be enabled, and the PID Setpoint source (P7.02) must be set to keypad (00).*

08 PID Feedback Signal (PV)
Displays the PID feed-back signal.

09 Frequency Setpoint
Displays the frequency setting of the AC drive.
Example: 60.0Hz

Programming the *DURAPULSE* AC Drive

The *DURAPULSE* AC Drive parameters are organized into eleven (11) different groups according to their functions, plus a special "Copy Keypad" function for storing up to four (4) different sets of program parameters into the keypad. The illustration below shows you how to navigate through the parameter groups and parameter settings. For a complete list of parameters, see CHAPTER 4.



1. Press the PROGRAM key and then use the UP/DOWN or PROGRAM keys to cycle through the parameter groups. The LCD display will show the parameter group that is currently selected.
2. 3. Press the ENTER key to display the various parameters for the selected group and use the UP/DOWN keys to view each one.
4. When the desired parameter is shown, press the ENTER key to select.
5. Use the UP/DOWN keys to cycle through the available settings.
6. Press the ENTER key to select the setting. The phrase "Value Accepted" will be displayed for a moment to show that the parameter value has been changed.
7. After the parameter value has been set, the LCD display will cycle to the next parameter in the selected group.

DURAPULSE Quickstart

The following examples will help you quickly set up your *DURAPULSE* AC Drive for two common applications. The first example applies to an application that requires constant torque, and the second example requires variable torque in its application.

For a complete list and description of the parameters for the DURAPULSE AC drives, see CHAPTER 4.

Example 1: Constant torque (e.g. conveyors, compressors, etc.)

In this example, the AC drive needs to operate a motor that is connected to a conveyor. In order to decide which parameters need modifications, we will make a list of the needs for the application.

Application Needs

- The AC drive must control a 460V, 1hp inverter duty motor. We will use a model GS3-41P0 AC drive for this application. An example of the motor nameplate is shown below.

INVERTER DUTY MOTOR							
HP	1	Volts	460	PHASE	3	TYPE	P
RPM	1725	AMPS	2.6	HZ	60	SF	1.15
DESIGN	B			AMB	40°C	INSUL CLASS	F
DUTY	CONT			ENCL	TEFC	CODE	K

- The maximum speed for the motor is 2000 rpm.
- The motor should accelerate to maximum speed in 5 seconds.
- The motor should decelerate from maximum speed in 5 seconds. (Applications with high starting torque reqirements and/or high inertia loads may require optional braking resistors.)
- The motor will require a high torque when starting.
- The operation of the motor (start, stop, etc.) will be controlled by remote control terminals. All keys on the *DURAPULSE* keypad should be disabled.
- The frequency of the AC drive will be determined by remote potentiometer that has a 0 to +10V signal.
- The display of the AC drive should default to the motor speed (rpm) when running.

Parameter Setup

In order to meet the needs of this application, the parameters should be set as follows:

P0.00 **Motor Nameplate Voltage** **Setting: 460**

Range: 230V series: 200/208/220/230/240 Default Setting: 240
460V series: 380/400/415/440/460/480 Default Setting: 480

This parameter setting is determined by the motor nameplate.

P0.01 **Motor Nameplate Amps** **Setting: 2.6**

Range: Drive Rated Amps x .1 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

This parameter setting is determined by the motor nameplate..

P0.02 **Motor Base Frequency** **Setting: 60**

Range: 50/60/400 Default Setting 60

This parameter setting is determined by the motor nameplate.

P0.03 **Motor Base RPM** **Setting: 1725**

Range: 375 to 24,000 RPM Default Setting: 1750

This parameter setting is determined by the motor nameplate.

P0.04 **Motor Maximum RPM** **Setting: 2000**

Range: P0.03 to 24,000 RPM Default Setting: P0.03

This parameter setting is determined by the needs of the application.

WARNING: The Motor Maximum RPM parameter (P0.04) should never exceed the maximum RPM rating for the motor that you are using. If this information is not readily available, consult your motor manufacturer.

P1.00 **Stop Methods** **Setting: 00**

Range: 00 Ramp to Stop
01 Coast to stop Default Setting: 00

The application requires that this parameter be set to Ramp to Stop because the motor needs to stop under power. (If the AC drive is set for Coast to Stop, the AC drive will ignore the Deceleration Time setting.)

WARNING: If the Stop Method for the *DURAPULSE* AC drive is set for Coast to Stop, the AC drive will ignore the (P1.02) setting for Deceleration Time.

P1.01 Acceleration Time — Setting: 5.0

Range: 0.1 to 600 sec — Default Setting: 10 sec

The motor should accelerate from 0 RPM to Maximum Motor RPM (P0.04) in 5 seconds.

P1.02 Deceleration Time — Setting: 5.0

Range: 0.1 to 600 sec — Default Setting: 30 sec

The motor should decelerate from 2000 rpm; Maximum Motor RPM (P0.04) to 0 RPM in 5 seconds.

P2.00 Volts/Hertz Settings — Setting: 01

Range: 00 - General Purpose — Default Setting: 0.0
01 - High Starting Torque
02 - Fans and Pumps
03 - Custom

The *DURAPULSE* AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this example, the application requires a high starting torque.

P3.00 Source of Operation Command — Setting: 02

Default Setting: 00

Settings	00	Operation Determined by Digital Keypad
	01	Operation determined by external control terminals. Keypad STOP is enabled.
	02	Operation determined by external control terminals. Keypad STOP is disabled.
	03	Operation determined by RS-485 interface. Keypad STOP is enabled.
	04	Operation determined by RS-485 interface. Keypad STOP is disabled.

The AC drive operation will be determined by external control terminals, and the keypad stop will be disabled.

If parameter P3.00 = 00, 01, or 03, enabling the keypad STOP key, the drive will stop if the keypad is removed from the drive.

P4.00 Source of Frequency Command Setting: 02

Default: 01

Settings:
- 01 Frequency determined by digital keypad up/down
- 02* Frequency determined by 0 to +10V input on AI1 terminal.
- 03 Frequency determined by 4 to 20 mA input on AI2 terminal.
- 04 Frequency determined by 0 to 20 mA input on AI2 terminal.
- 05 Frequency determined by RS-485 communication interface
- 06 Frequency determined by-10V~+10V input on AI3 terminal

** In order to set P4.00 = 02, you must first change the value of P4.13 to some value other than two (02) in order to avoid the "Error: Duplicate Function" error message. (P4.13 default value is 02)*

P6.00 Electronic Thermal Overload Relay Setting: 00

Default: 00

Settings:
- 00 Constant Torque (inverter/vector duty motor)
- 01 Variable Torque (fan-cooled standard motor)
- 02 Inactive

This function setting 00 is the standard overload protection curve used to protect inverter/vector duty motors.

P8.00 User Defined Display Function Setting: 01

Default Setting: 00

Settings:
- 00 Output Frequency (Hz)
- 01 Motor Speed (RPM)
- 02 Scaled Frequency
- 03 Output Current (A)
- 04 Motor Load (%)
- 05 Output Voltage(V)
- 06 DC Bus Voltage (V)
- 07 PID Setpoint
- 08 PID Feedback (PV)
- 09 Frequency Setpoint

The AC drive display will default to motor speed (rpm) when running.

Example 2: Variable torque (e.g. fans, centrifugal pumps, etc.)

In this example, the AC drive needs to operate a motor that is connected to a centrifugal pump. As in Example 1, we will make a list of the needs for the application in order to decide which parameters need modifications.

Application Needs

- The AC drive must control a 208V, 3hp fan-cooled standard duty motor. The AC drive model we will be using for this application is a GS3-23P0. An example of the motor nameplate is shown below.

STANDARD DUTY MOTOR							
HP	3	Volts	208	PHASE	3	TYPE	P
RPM	3525	AMPS	9.2	HZ	60	SF	1.15
DESIGN	B			AMB	40°C	INSUL CLASS	F
DUTY	CONT			ENCL	TEFC	CODE	K

- The maximum speed for the motor is 3600 rpm.
- The motor should accelerate to maximum speed in 20 seconds.
- The motor should coast to stop when operation is terminated.
- The motor will be turning a centrifugal pump.
- The operation of the motor (start, stop, etc.) will be controlled by the *DURAPULSE* digital keypad.
- The frequency of the AC drive will be determined by the *DURAPULSE* keypad potentiometer.
- The display of the AC drive should default to output current (A) when running.

Parameter Setup

In order to meet the needs of this application, the parameters should be set as follows:

P0.00 **Motor Nameplate Voltage** **Setting: 208**

Range: 230V series: 200/208/220/230/240 Default Setting: 240
460V series: 380/400/415/440/460/480 Default Setting: 480

This parameter setting is determined by the motor nameplate.

P0.01 **Motor Nameplate Amps** **Setting: 9.2**

Range: Drive Rated Amps x 0.1 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

This parameter setting is determined by the motor nameplate.

P0.02 **Motor Base Frequency** **Setting: 60**

Range: 50/60/400 Default Setting 60

This parameter setting is determined by the motor nameplate.

P0.03 **Motor Base RPM** **Setting: 3525**

Range: 375 to 24,000 RPM Default Setting: 1750

This parameter setting is determined by the motor nameplate.

P0.04 **Motor Maximum RPM** **Setting: 3600**

Range: P0.03 to 24,000 RPM Default Setting: P0.03

This parameter setting is determined by the needs of the application.

WARNING: The Motor Maximum RPM parameter (P0.04) should never exceed the maximum rpm rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

P1.00 **Stop Methods** **Setting: 01**

Range: 00 Ramp to Stop Default Setting: 00
01 Coast to stop

The application requires that this parameter be set to Coast to Stop.

WARNING: If the Stop Method for the *DURAPULSE* AC drive is set for Coast to Stop, the AC drive will ignore the Deceleration Time (P1.02) setting.

P1.01 **Acceleration Time** **Setting: 20.0**

Range: 0.1 to 600 sec Default Setting: 10 sec

The motor should accelerate from 0 RPM to Maximum Motor RPM (P0.04) in 20 seconds.

P2.00 Volts/Hertz Settings — Setting: 02

Range: 00 - General Purpose
01 - High Starting Torque
02 - Fans and Pumps
03 - Custom

Default Setting: 00

The *DURAPULSE* AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this example, the motor will be running a pump.

In some applications it is perfectly acceptable to leave this parameter set for "00" - General Purpose.

P3.00 Source of Operation Command — Setting: 00

Default Setting: 00

Settings	00	Operation Determined by Digital Keypad
	01	Operation determined by external control terminals. Keypad STOP is enabled.
	02	Operation determined by external control terminals. Keypad STOP is disabled.
	03	Operation determined by RS-485 interface. Keypad STOP is enabled.
	04	Operation determined by RS-485 interface. Keypad STOP is disabled.

The AC drive operation will be determined by the Digital Keypad.

If parameter P3.00 = 0, 1, or 3, enabling the keypad STOP key, the drive will stop if the keypad is removed from the drive.

P4.00 Source of Frequency Command — Setting: 00

Default: 01

Settings:
- 01 Frequency determined by digital keypad up/down
- 02* Frequency determined by 0 to +10V input on AI1 terminal.
- 03 Frequency determined by 4 to 20 mA input on AI2 terminal.
- 04 Frequency determined by 0 to 20 mA input on AI2 terminal.
- 05 Frequency determined by RS-485 communication interface.
- 06 Frequency determined by -10V ~ +10V input on AI3 terminal

** In order to set P4.00 = 02, you must first change the value of P4.13 to some value other than two (02) in order to avoid the "Error: Duplicate Function" error message. (P4.13 default value is 02)*

P6.00 Electronic Thermal Overload Relay — Setting: 01

Default Setting: 00

Settings:
- 00 Constant Torque (inverter/vector duty motor)
- 01 Variable Torque (fan-cooled standard motor)
- 02 Inactive

This function setting 01 is used to derate the AC drive output current overload protection to protect a fan-cooled standard motor running at low speeds.

P8.00 User Defined Display Function — Setting: 03

Default Setting: 00

Settings:
- 00 Output Frequency (Hz)
- 01 Motor Speed (RPM)
- 02 Scaled Frequency
- 03 Output Current (A)
- 04 Motor Load (%)
- 05 Output Voltage(V)
- 06 DC Bus Voltage (V)
- 07 PID Setpoint
- 08 PID Feedback (PV)
- 09 Frequency Setpoint

The AC drive display will default to indicate Output Current (A) when running.

For a complete list and description of the parameters for the DURAPULSE AC drives, see CHAPTER 4.

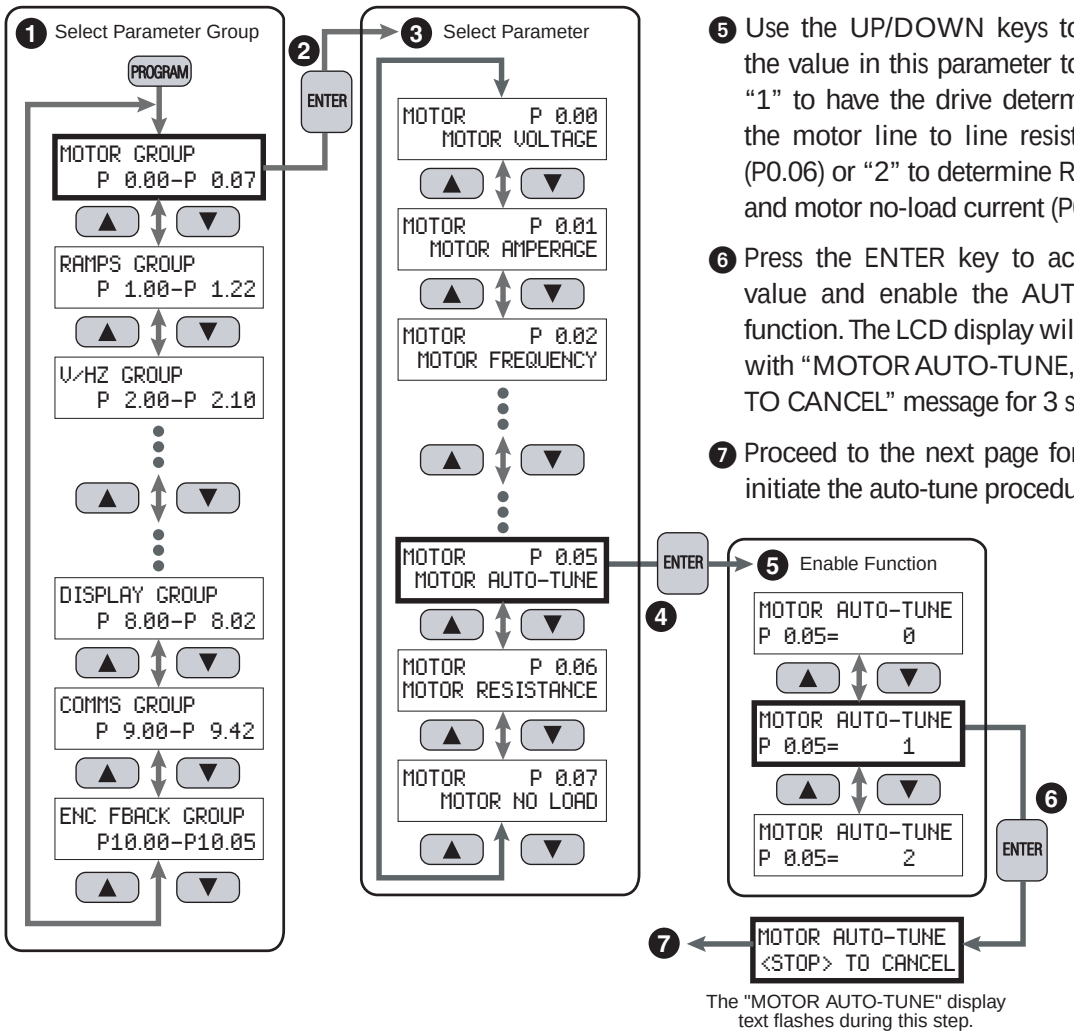
Auto-Tune Procedure

Auto-tuning is required only for Sensorless Vector Control Modes (P2.10 = 02, 03, 05).

WARNING: The motor will rotate when executing the auto-tuning procedure. It is also very important that no load be connected to the motor output shaft at the time the auto-tune procedure is performed.

The *DURAPULSE* AC drive is capable of performing an auto-tune procedure when a motor is connected to the AC drive. It is also very important for safety and functional reasons that no load be physically connected to the motor output shaft during auto-tuning. The auto-tune will begin when the RUN key is pressed on the AC drive keypad. To enable the Auto-Tune procedure, do the following:

1. Press the PROGRAM key repeatedly until the MOTOR GROUP, P0.00-P0-07, is displayed on the keypad LCD display.
2. Press the ENTER key to display the various parameters for this group.
3. Use the UP/DOWN keys to display parameter P0.05, MOTOR AUTO-TUNE.
4. Press the ENTER key to display the current value for this parameter.



The "MOTOR AUTO-TUNE" display text flashes during this step.

5. Use the UP/DOWN keys to change the value in this parameter to either a "1" to have the drive determine only the motor line to line resistance R1 (P0.06) or "2" to determine R1 (P0.06) and motor no-load current (P0.07).
6. Press the ENTER key to accept this value and enable the AUTO-TUNE function. The LCD display will indicate with "MOTOR AUTO-TUNE, <STOP> TO CANCEL" message for 3 seconds.
7. Proceed to the next page for steps to initiate the auto-tune procedure.

It is not necessary to set up the encoder and control mode before performing the auto-tuning function. (Auto-tuning is required only for the sensorless vector control modes.)

Do NOT set auto-tuning without a motor connected to the drive.
Do NOT set auto-tuning with any mechanical load connected to the motor output shaft.

Auto-Tune Instructions

If the drive is set to auto-tune with no motor connected, the drive will go into an infinite auto-tune loop without access to the parameter groups. To correct this situation, simply power down the unit, connect the motor, complete auto-tuning (even if incorrect), reset factory default (9.08 = 99), and then start over.

1. Make sure all wiring is correctly connected to the AC drive and motor.
2. Make sure there is no load connected to the motor's output shaft, including any belts or gear boxes.
3. Program parameters P0.00, P0.01, P0.02, P0.03 and P0.04 with the correct values for the motor being used.
4. After enabling the Auto-Tune parameter P0.05 as shown on the previous page for either a "1" to have the AC drive determine only the motor line to line resistance R1 (P0.06), or a "2" to determine R1 (P0.06) and the motor's no-load current (P0.07), the message MOTOR AUTO-TUNE (flashing), <STOP> TO CANCEL will appear on the keypad LCD display for a 3 second period. If the STOP key is pressed during this time, the Auto-Tune procedure will terminate, the value in parameter P0.05 will reset to "0" and the LCD display will return to the display mode.
5. After the confirmation message is shown, (the AC drive is ready to perform an Auto-Tune), the keypad LCD will display the message PRESS <RUN>, TO CONTINUE for 60 seconds. Once the RUN key is pressed, the display will show DETECTING MOTOR (flashing), <STOP> TO CANCEL. If the STOP key is pressed, the Auto-Tune procedure will terminate, the keypad LCD display will show either a "R1 Detect Error" or "No Load Error" warning message, and the value in parameter P0.05 will reset to "0". Use the STOP/RESET key to clear the warning message and return the drive to the display mode. Then repeat the procedure.
6. The Auto-Tune procedure will take approximately 15 seconds to execute, plus the acceleration and deceleration times in parameters P1.01 and P1.02. (The greater the horsepower of the AC drive and motor, the more acceleration and deceleration time will be required.)
7. Upon completion of the Auto-Tune procedure, the display will show the message TUNING COMPLETE, PRESS <ENTER>. At this time, the determined values for parameters P0.06 and P0.07 will be filled in automatically. Please check these parameters to make sure a value was determined. If no value was determined, then repeat the procedure.
8. If the STOP/RESET key on the keypad is pressed during auto-tuning, or if the RUN key is not pressed within 60 seconds once the message PRESS <RUN>, TO CONTINUE is displayed, the Auto-Tune procedure will terminate and the value in parameter P0.05 will reset to "0". The *DURAPULSE* AC drive will return to the normal display mode.

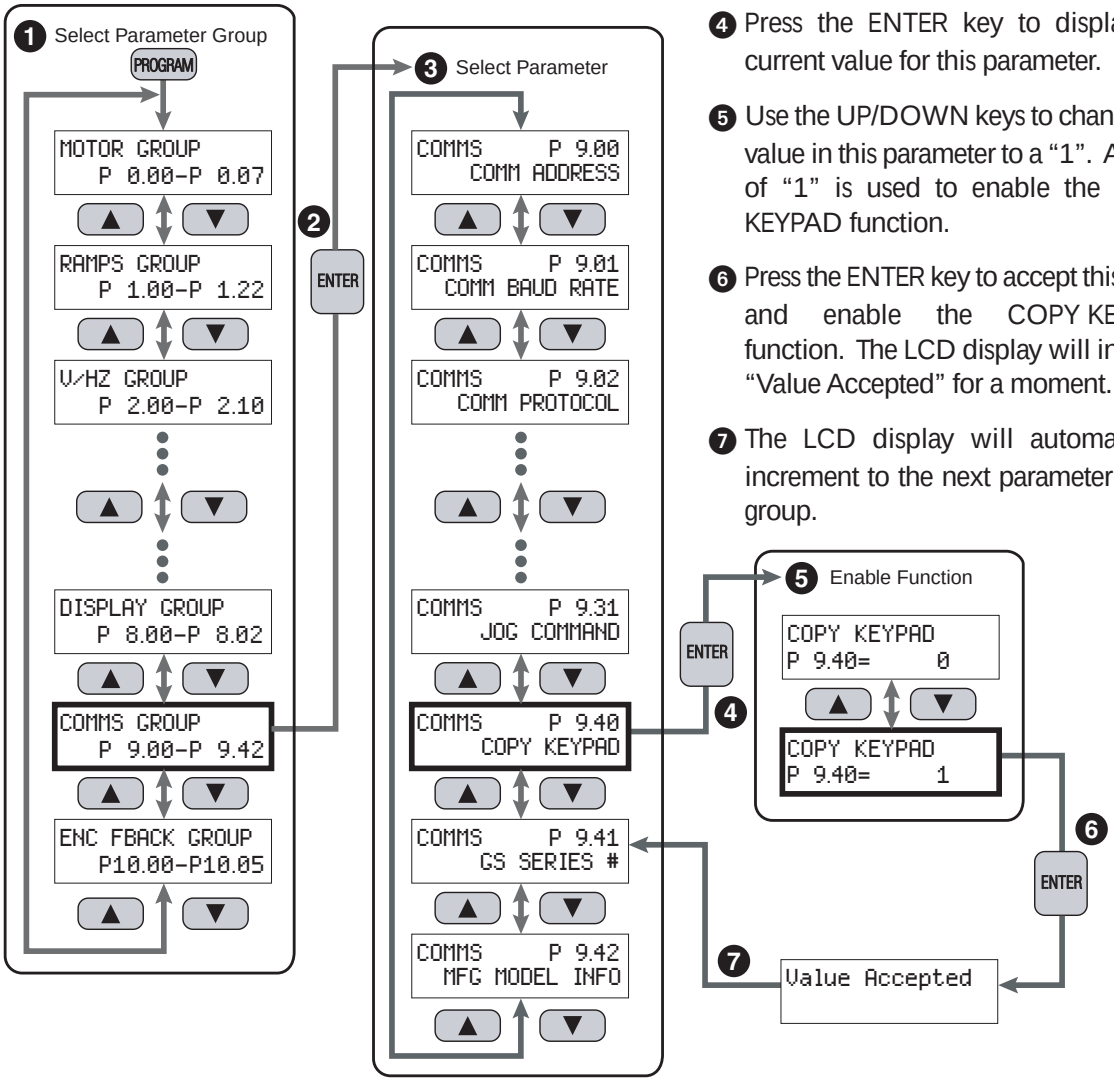
Copy Keypad Function

The COPY KEYPAD function has the ability to permanently store up to four (4) different program parameter settings within the keypad device. The stored parameter settings can be for any of the *DURAPULSE* AC Drives. This allows the parameter settings to be backed-up and readily available for either duplicating the same multiple AC drives or for maintenance use if a drive needs to be replaced.

It is recommended that once the application has been programmed, the parameter settings be backed-up in the keypad for future use and maintenance.

Enable Copy Keypad Function

1. Press the PROGRAM key repeatedly until the COMMS GROUP, P9.00 - P9.42, is displayed on the keypad LCD display.
2. Press the ENTER key to display the various parameters for this group.
3. Use the UP/DOWN keys to display parameter P9.40, the COPY KEYPAD function.

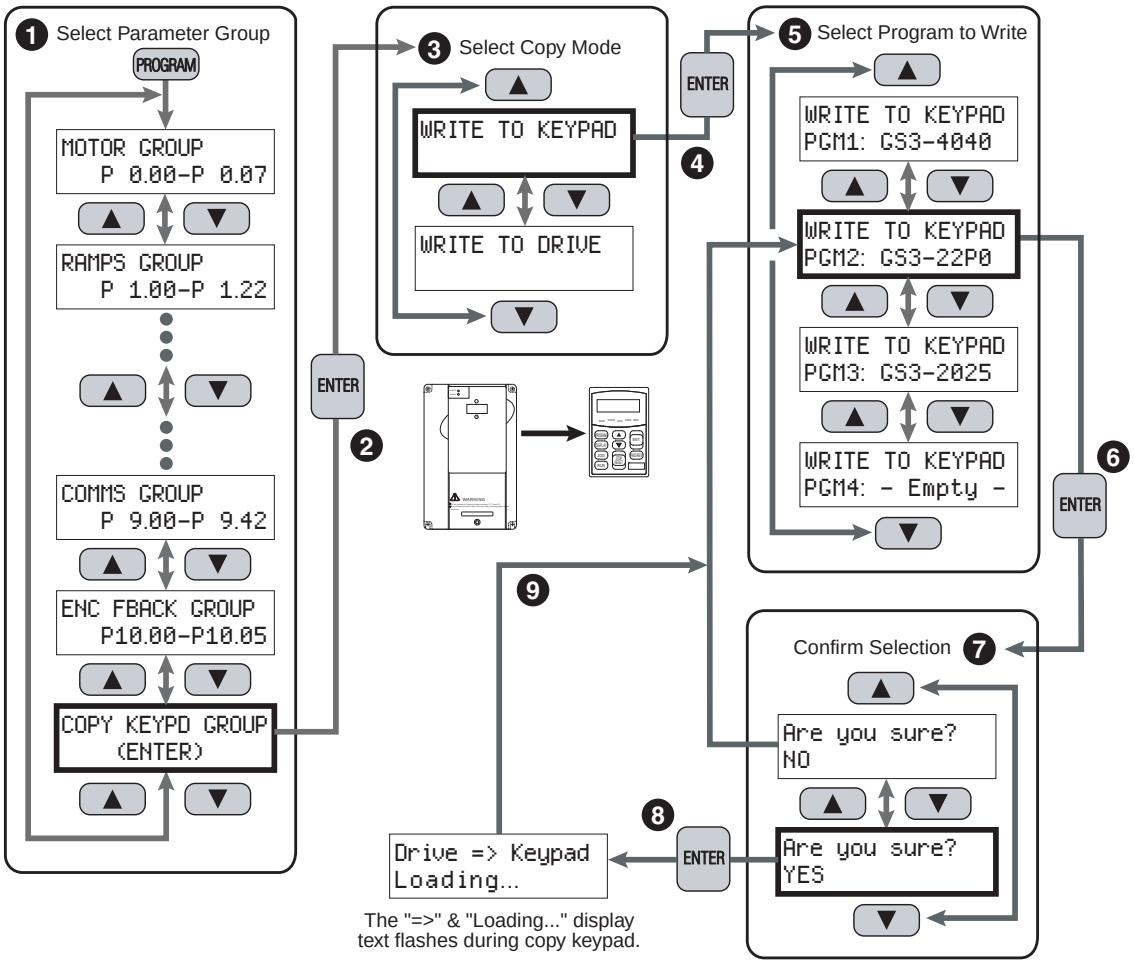


4. Press the ENTER key to display the current value for this parameter.
5. Use the UP/DOWN keys to change the value in this parameter to a "1". A value of "1" is used to enable the COPY KEYPAD function.
6. Press the ENTER key to accept this value and enable the COPY KEYPAD function. The LCD display will indicate "Value Accepted" for a moment.
7. The LCD display will automatically increment to the next parameter in the group.

Write Parameter Settings to Keypad

WARNING: Do not remove the Keypad during transfer of program parameter settings to or from the AC drive.

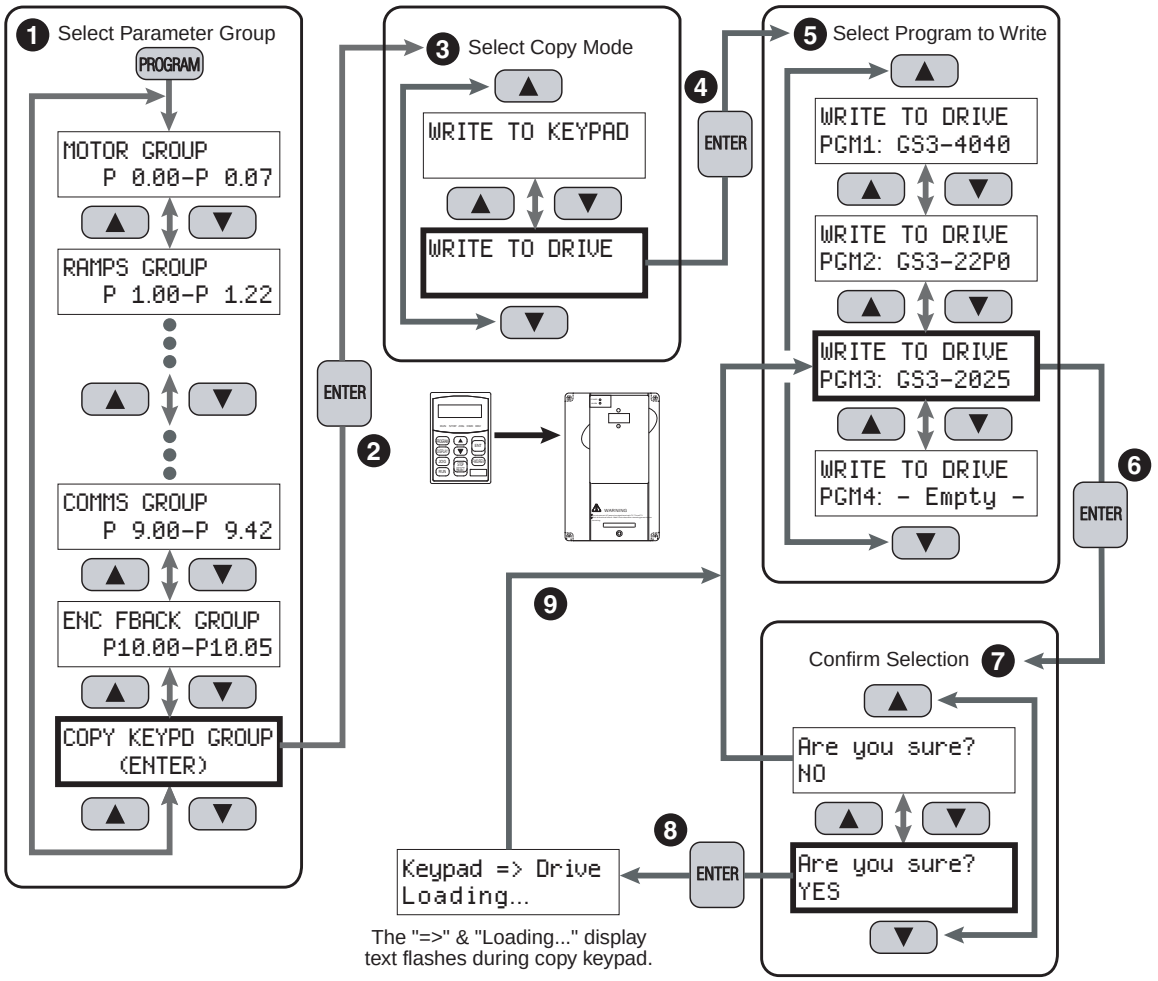
1. After P9.40 COPY KEYPAD is enabled, the LCD display will show an additional group called COPY KEYPD GROUP. Press the PROGRAM key and then the UP/DOWN or PROGRAM keys until this new group is displayed.
2. Press the ENTER key to display the copy mode selections.
3. Select the WRITE TO KEYPAD mode using the UP/DOWN keys.
4. Press the ENTER key to display the four (4) available program numbers to write from the AC drive to the keypad. The program name will automatically be named the part number of the AC drive, for example: GS3-22P0.
5. 6. Use the UP/DOWN keys to select the desired program number; PGM1 thru PGM4 and press the ENTER key.
7. 8. Use the UP/DOWN keys to select "Yes" to confirm and press the ENTER key.
9. The LCD display will show the message "Drive => Keypad, Loading..." while the parameters are being copied and return to the program selection when finished. (Does not restore P9.40 back to Disable Copy Keypad Function.)



Write Parameter Settings to Drive

WARNING: Do not remove the Keypad during transfer of program parameter settings to or from the AC drive.

1. After the COPY KEYPAD parameter is enabled, the LCD display will show an additional group called COPY KEYPD GROUP. Press the PROGRAM key and then the UP/DOWN or PROGRAM keys until this new group is displayed.
2. Press the ENTER key to display the copy mode selections.
3. Select the WRITE TO DRIVE mode using the UP/DOWN keys.
4. Press the ENTER key to display the four (4) available program numbers to write from the keypad to the AC drive. The program name must match the part number of the AC drive being programmed; for example: GS3-2025.
5. 6. Use the UP/DOWN keys to select the desired program number; PGM1 thru PGM4 and press the ENTER key.
7. 8. Use the UP/DOWN keys to select "Yes" to confirm and press the ENTER key.
9. The LCD display will show the message "Keypad => Drive, Loading..." while the parameters are being copied and return to the program selection when finished.



Use the PROGRAM key to back out of the various menu selections without saving changes.

The warning message RATING MISMATCH will be displayed on the LCD display if trying to do a WRITE TO DRIVE copy mode and selecting an existing program that does not match the drive being used.

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CHAPTER 6

MAINTENANCE AND TROUBLESHOOTING

In This Chapter...

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- Annual Inspection 6–2
- Recharge Capacitors (for unused drives) 6–2

Troubleshooting 6–3
- Fault Messages 6–3
- Warning Messages: Serial Communication and Keypad Errors . . .6–7

Maintenance and Inspection

Modern AC drives are based on solid state electronics technology. Preventive maintenance is required to operate the AC drive in its optimal condition, and to ensure a long life. We recommend that a qualified technician perform a regular inspection of the AC drive. Some items should be checked once a month, and some items should be checked yearly.

If the drive is stored or is otherwise unused for more than a year, the drive's internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year.

WARNING! Disconnect AC power and ensure that the internal capacitors have fully discharged before inspecting the AC drive!
Wait at least two minutes after all display lamps have turned off.

Monthly Inspection

Check the following items at least once a month.

1. Make sure the motors are operating as expected.
2. Make sure the installation environment is normal.
3. Make sure the cooling system is operating as expected.
4. Check for irregular vibrations or sounds during operation.
5. Make sure the motors are not overheating during operation.
6. Check the input voltage of the AC drive and make sure the voltage is within the operating range. Check the voltage with a voltmeter.

Annual Inspection

Check the following items once annually.

1. Tighten and reinforce the screws of the AC drive if necessary. They may loosen due to vibration or changing temperatures.
2. Make sure the conductors and insulators are not corroded or damaged.
3. Check the resistance of the insulation with a megohmmeter.
4. Check the capacitors and relays, and replace if necessary.
5. Clean off any dust and dirt with a vacuum cleaner. Pay special attention to cleaning the ventilation ports and PCBs. Always keep these areas clean. Accumulation of dust and dirt in these areas can cause unforeseen failures.
6. Recharge the capacitors of any drive that is in storage or is otherwise unused.

Recharge Capacitors (for unused drives)

Recharge the DC link before using any drive that has not been operated within a year:

1. Disconnect the motor from the drive.
2. Apply input power to the drive for 2 hours.

Troubleshooting

Fault Messages

The AC drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The fault messages are then displayed on the digital keypad LCD display. The six most recent faults can be read on the digital keypad display by viewing parameters P06.31 to P06.36.

NOTE: Faults can be cleared by a reset from the keypad or input terminal.

Fault Messages	
Fault Name/Description	**Corrective Actions**
OVER-CURRENT The AC drive detects an abnormal increase in current.	1. Check whether the motor's horsepower is equal to or less than the AC drive output power. 2. Check the wiring connections between the AC drive and motor for possible short circuits. 3. Increase the Acceleration time (P 1.01 or P 1.05). 4. Check for possible excessive loading conditions at the motor. 5. If there are any abnormal conditions when operating the AC drive after short-circuit is removed, or fault does not clear, call ADC Support for assistance.
OVER-VOLTAGE The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.	1. Check whether the input voltage falls within the rated AC drive input voltage. 2. Check for possible voltage transients. 3. Bus over-voltage may also be caused by motor regeneration. Either increase the decel time or add an optional braking resistor. 4. Check whether the required braking power is within the specified limits. 5. Check braking resistor on drives under 20HP and dynamic brake unit & braking resistor on drives 20HP and above.
OVER-TEMPERATURE The AC drive temperature sensor detects excessive heat.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects on the heat sinks and check for possible dirty heat sink fins. 4. Provide enough spacing for adequate ventilation.
UNDER-VOLTAGE The AC drive detects that the DC bus voltage has fallen below its minimum allowable value.	Check whether the input voltage falls within the rated AC drive input voltage.
OVERLOAD The AC drive detects excessive drive output current.	1. Check whether the motor is overloaded. 2. Reduce torque compensation setting as set in P 2.03. 3. Increase the AC drive's output capacity. **Note: The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.**

Fault Messages	
Fault Name/Description	**Corrective Actions**
THERMAL OVERLOAD Parameter settings (P 6.07 to P 6.09) An external condition has occurred to cause an internal electronic or motor thermal overload fault	If P 6.07 is set to '1' to enable during steady state: 1. Check for possible motor overload. 2. Check electronic thermal overload relay setting (P 6.00).. 3. Increase motor capacity. 4. Reduce the current level so that the AC drive output current does not exceed the value set by the Motor Rated Current P 0.01.
OVER-TORQUE Parameter settings (P 6.07 to P 6.09) An external condition has occurred to cause an over-torque fault.	If P 6.07 is set to '2' to enable detection during accel/decel: 1. Reduce the motor overload. 2. Adjust the over-torque detection setting to an appropriate level.
OVER-CURRENT ACC Over-current during acceleration: 1. Short-circuit at motor output. 2. Torque boost too high. 3. Acceleration time too short. 4. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Decrease the torque boost setting in P 2.02. 3. Increase the acceleration time P 1.01 and P 1.05. 4. Replace the AC drive with one that has a higher output capacity.
OVER-CURRENT DEC Over-current during deceleration: 1. Short-circuit at motor output. 2. Deceleration time too short. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Increase the deceleration time P 1.02 and P 1.06. 3. Replace the AC drive with one that has a higher output capacity.
OVER-CURRENT STD Over-current during steady state operation 1. Short-circuit at motor output. 2. Sudden increase in motor loading. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Check for possible motor stall. 3. Replace the AC drive with one that has a higher output capacity.
CPU FAILURE 1 Internal memory IC cannot be programmed	1. Switch off power supply. 2. Check whether the input voltage falls within the AC drive's rated input voltage. 3. Switch the AC drive back on. If fault does not clear, contact ADC Support for assistance.
CPU FAILURE 2 Internal memory IC cannot be read.	1. Reset drive to factory defaults P 9.08 to 99. 2. Switch off power supply 3. Switch the AC drive back on. If fault does not clear, contact ADC Support for assistance.
CPU FAILURE 3 Internal memory IC failed to receive output status	1. Check all connections at L1, L2 and L3. 2. Verify correct voltage at L1, L2,L3. 3. Contact ADC Support for assistance.

Fault Messages	
Fault Name/Description	**Corrective Actions**
HARDWARE FAILURE Hardware protection failure	1. Check all connections at L1, L2 and L3. 2. Verify correct voltage at L1, L2,L3. 3. Contact ADC Support for assistance.
MOM POWER LOSS Input power has been lost	Check line power to drive
EXTERNAL FAULT The external terminal EF-CM goes from OFF to ON	When external terminal EF-CM is closed, the output will be turned off (under Normally Open. External Fault.).
AUTO RAMP FAULT Auto accel/decel failure	Refer to Over-current or Over-voltage error
GROUND FAULT 1. Possible unbalanced load 2. Possible current leakage	1. Check the motor for possible insulation damage. 2. Check for possible poor insulation at the output line.
EXT. BASE-BLOCK AC drive output is turned off.	1. When the external input terminal (base-block) is active, the AC drive output will be turned off. 2. Disable this connection and the AC drive will begin to work again.
INPUT POWER LOSS One phase of the input power is lost	1. Check for possible poor connection on the input power line. 2. Check for possible loss of phase on input power line.
OUTPUT SHORTED IGBT Short Circuit	Contact ADC Support for assistance.
PID FBACK LOSS 1. If P 7.27 = 0, (*warn and AC drive stop),* PID feedback loss recorded. 2. If P 7.27 = 1, (*warn and continue operation)*, PID feedback loss not recorded.	PID Warning: PID Feedback Loss - The 4-20mA PID signal has been lost. The corrective action can be set with the PID Feedback Loss parameter (P 7.27). The available settings are: 00 - Warn and AC Drive Stop 01 - Warn and Continue The default setting is 00.

Fault Messages	
Fault Name/Description	**Corrective Actions**
ENCODER LOSS 1. If P 10.05 = 1 or 2 (*warn and AC drive stop*), Encoder feedback loss would be recorded. 2. If P 10.05 = 0 (*warn and continue operation*), Encoder feedback loss would not be recorded.	1. Verify that the encoder board has power 2. Check to be sure it is not mis-wired 3. Check for incorrect voltage or encoder set-up 4. Check both the mechanical and electrical integrity of the encoder.
ENC SIGNAL ERROR Encoder A/B phase signal is in error when the control mode is from the encoder	1.Verify power to the encoder feedback card 2. Verify encoder and feedback card wiring 3. Check encoder feedback card dip switch settings and encoder voltage requirements

Warning Messages: Serial Communication and Keypad Errors

There are several Warning Messages that a *DURAPULSE* AC Drive may give. The *DURAPULSE* AC Drive allows you to decide its response to these messages. The descriptions of the Warning Messages are listed below.

Warning Messages	
Error Name	**Description**
No display shown on the keypad	1. The Keypad LCD display has failed. 2. Check input power 3. Make sure the keypad is tightly connected to the drive.
Invalid Cmd Code	Invalid Command Code when communicating
Invalid Address	Invalid Address when communicating
Invalid Data	Invalid Data when communicating
Slave Comm Fault	Slave Comm Fault device failure
Comm Time-Out	Communication Time Out
Drive Error	Drive model doesn't match keypad
EEPROM Fault	When the copy function is enabled (P 9.40), there is a Read/Write EEPROM Fault

Warning Messages	
Error Name	**Description**
Rating Mismatch	Data range doesn't match
Group# Overflow	When the copy function is enabled (P 9.40), keypad's group number data is more than the drive's.
No Space	When the copy function is enabled (P 9.40),EEPROM data block in the keypad is full.
Delete Failure	When the copy function is enabled (P 9.40), delete EEPROM block fails.
No Data	When the copy function is enabled (P 9.40), EEPROM data block is null.
R1 Detect Error Failure to detect motor resistance during Auto-tune procedure	1. Check to make sure the motor is connected to the drive correctly. 2. Check line power to drive 3. STOP key was pressed during Auto-Tune procedure
No Load Error Failure to detect any motor load during Auto-tune procedure	1. Check to make sure the motor is connected to the drive correctly. 2. Check line power to drive 3. STOP key was pressed during Auto-Tune procedure
Copy Error-COMMS Communications error during Copy Keypad function	1.Check connection between the keypad and drive and make sure it is not loose 2. Check communications protocol for correct settings
Copy Error-Data Data error during Copy Keypad function	1. Check connection between the keypad and drive and make sure it is not loose 2. Check communications protocol for correct settings

Warning Messages	
Error Name	**Description**
Overheat Warning The AC drive temperature has exceeded 85% of the Over-temperature condition.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects on the heat sinks and check for possible dirty heat sink fins. 4. Provide enough spacing for adequate ventilation.
Write Failure	When the copy function is enabled (P 9.40),Write to EEPROM fails.
Parameter Locked	Parameters have been locked: read only - cannot be set/cannot write.
--- ERR ---	Error: The configuration is not accepted, or the parameter is locked.
Value Accepted	Value Accepted.
Error: Duplicate Function	This occurs when attempting to set two mutually exclusive parameters to the same value. This is most commonly seen when P4.00 and P4.13 are both set to the same value. (Firmware version 1.04 or higher only.)

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O&M COVER SHEET

SECTION: 5
PRODUCT: STARTERS

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PROJECT: **Pinewood Atlanta - Building 3**

LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

DATE RECEIVED:	06/05/14
MANUFACTURER:	GE
SUPPLIER:	GAA
SUBMITTED DATE:	06/05/14

[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

THIS APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE SUBCONTRACTOR OR VENDOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

CHECKED BY:	WILLIAM HAGLER
DATE CHECKED:	06/05/14

300-Line Magnetic Contactors and Starters–CR305/CR306 NEMA Size 2

Caution: Before installing in a nuclear application, determine that the product is intended for such use.

Warning: Disconnect power before installing or servicing.

Description

GE's 300-Line full-voltage magnetic motor starters include a magnetic contactor and a three-leg block overload relay, providing motor protection against running and stalled motor overloads. The overload relay is provided with a yellow trip indicator which is located to the right of the reset arm, and is visible when the overload relay is tripped. (Series A forms will not have this trip indicator feature.) To insure against welded overload relay contacts in the tripped condition, perform the *Check For Welded Contacts In Overload Relay* as described below.

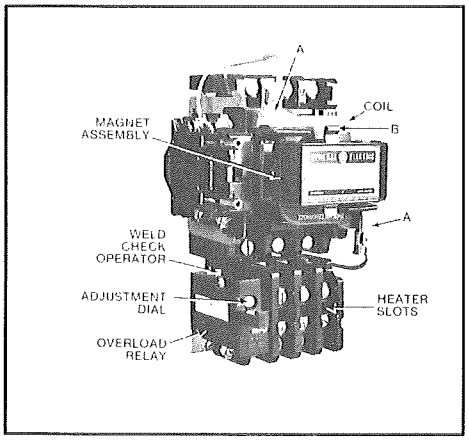


Figure 1. Typical 300-Line magnetic starter.

Ratings

CR305 contactors are suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 600 volts maximum when protected by H, J, K1, K5, RK1, RK5 class fuses or a circuit breaker having an interrupting rating not less than 5,000 rms symmetrical amperes, 600 volts maximum.

Provide motor branch and control circuit overcurrent protection in accordance with the National Electrical Code.

Installation

Before connecting the starter:

1. Remove all packing.
2. Clean magnet mating surfaces of any dirt or foreign matter.
3. Select and install heater(s) in accordance with heater table, which accompanies each starter unit.
4. Operate movable magnet and operating arm by pressing on the armature to assure free movement.
5. Mount starter on a sturdy vertical support.
6. Make the electrical connections.
7. The overload relay can be reset manually by depressing and releasing the reset arm. The optional normally open contact on overload relays is electrically isolated from the normally closed contact.

Coil Removal

The encapsulated coil is impervious to moisture, contaminants and oil. It resists mechanical damage and failures due to high humidity. No tools are required to remove coil.

1. Remove all power from device.
2. Press against coil while pulling up slightly on coil retainers, (A–Fig. 1) and move retainers away from coil.
3. Withdraw magnet assembly, coil, molded cover, and movable arm from device.
4. Withdraw spring clip (B–Fig. 1) and remove armature from movable arm.
5. Remove coil from magnet.
6. Replace coil.
7. Reassemble device by reversing procedure.

Contact Removal

Movable contacts can be inspected and replaced in seconds – without tools.

1. Perform steps 1 through 5 under *Coil Removal.*
2. Remove magnet from molded cover and movable arm.
3. Remove return spring from center of movable arm.
4. Remove molded cover from movable arm.
5. Depress and slide movable contact and spring from movable arm.
6. Remove screws holding stationary contacts in place and remove stationary contacts.
7. Reassemble device by reversing procedure.

NOTE: Do not attempt to remove or replace Arc Traps in Arc Chute Cover.

When reassembling, note that the Arc Chute Cover will only fit one way and is marked "TOP" in upper right-hand corner. Magnet and movable arm will fit either way but will be quieter if reassembled the same way they were taken apart.

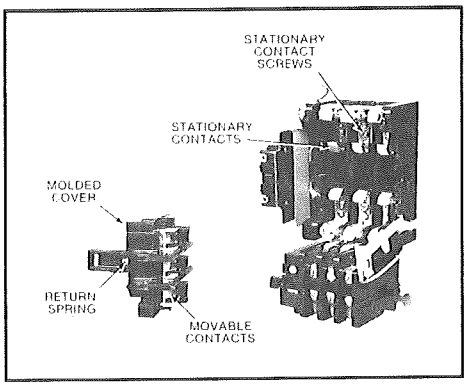


Figure 2.

Check For Welded Contacts In Overload Relay

This feature permits the maintenance person to check for welded contacts. With power disconnected from the device, disconnect the control wiring from the terminals of the relay and place a bell set or resistance measuring instrument across the relay terminals. Depress and release the reset arm to insure the relay is reset. In this condition there should be continuity between the terminals. Depress the white manual check operator to trip the relay. In the tripped condition the circuit between the terminals should be open indicating the contacts are operating normally. Remove the bell set or resistance measuring apparatus, rewire the relay terminals and reset the relay for normal operation.

Maintenance

300-Line starters require virtually no corrective maintenance. Preventive maintenance will assure many years of dependable on-line service.

1. Always remove power from device before performing any maintenance.
2. Keep magnet mating surfaces free of accumulated dirt or dust.
3. *DO NOT OIL OR GREASE* the magnet mating surfaces.
4. Contacts are carefully designed for maximum life. They need only be replaced when nearly all the silver tip is gone and the contact tip support is exposed. *DO NOT FILE* the contacts. Filing or otherwise dressing the contacts only results in lost tip material and reduces starter life.
5. The ultimate tripping current of the installed relay heater can be adjusted ±10% by using adjustment dial shown in Figure 1.

Coil Data

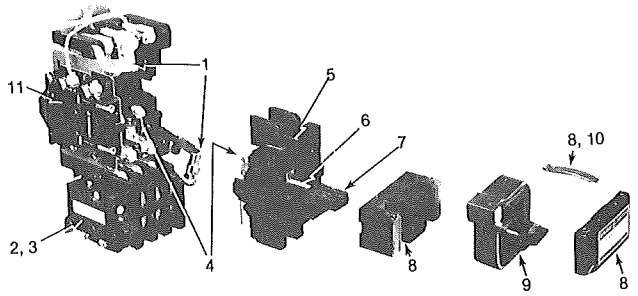
For two- and three-pole devices, order Cat. No. 15D22G plus number in table.
For four- and five-pole devices, order Cat. No. 15D23G plus number in table.

Frequency	115V	200/208V	230V	460V	575V	600V
60 Hertz	002	023	003	004	005	006
Frequency	**110V**	**220V**	**380V**	**440V**	**550V**	**600V**
50 Hertz	007	008	064	009	010	011

Use 022 for 120V 60 Hertz / 110V 50 Hertz coil.

Accessory Kits

1 st NO aux. contact for CR305 (right side mounting)	CR305X200A
1 st NC aux. contact for CR305 (right side mounting)	CR305X200B
1 st NO–NC aux. contact for CR305 (right side mounting)	CR305X200C
Additional NO aux. contact for all forms	CR305X100D
Additional NC aux. contact for all forms	CR305X100E
Push button	CR305X220N
Selector Switch, H-O-A	CR305X230N
Selector Switch, OFF-ON	CR305X230D
Indicating Light	CR305X250N
Fifth pole (for adding to 4-pole form only)	CR305X211B
Control circuit fuse	CR305X241A, B, C, D



Principal Renewal Parts

Ref. No.	Description	Catalog Number	Quantity Required	
			CR305	CR306
1	Coil Retainer Assembly	546A780G052	2	2
2	Overload relay (3-heater, non-compensated form, 1 NC contact)	CR324D310FX	–	1
3	Overload relay (3-heater, non-compensated form, 1 NO–1 NC contacts)	CR324D360F	–	1
4	Set of stationary and movable contacts with springs and screws for 3 poles	546A780G051	1	1
5	Molded cover for stationary and movable contacts	546A780G054	1	1
6	Return spring for movable contact support	547A524G001	1	1
7	Molded movable contact support for 2, 3 poles	188D700P001	1	1
8	Armature and frame (magnet) with retainer	546A780G053	1	1
9	Operating coil for 2- and 3-pole forms	15D22G***	1	1
10	Spring retainer for armature	546A627P001	1	1
11	Cross electrical interlock	CR305X200C	1	1

***Add suffix numbers for particular coil rating required. See *COIL TABLE* above.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the nearest GE Sales Office.

GE Industrial Systems

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